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LUNAR DISTANCES



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NEW METHOD

OF

Louis B. Stewart
Toronto

CORRECTING LUNAR DISTANCES,

AND

IMPROVED METHOD

OF FINDING THE

ERROR AND RATE OF A CHRONOMETER

BY

EQUAL ALTITUDES.

By WILLIAM CHAUVENET, LL. D.,

CHANCELLOR OF WASHINGTON UNIVERSITY, ST. LOUIS, LATE PROFESSOR OF MATHEMATICS AND ASTRONOMY
IN THE U. S. NAVAL ACADEMY, ETC.

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NEW METHOD
OF
CORRECTING LUNAR DISTANCES.

FROM THE APPENDIX TO THE AMERICAN EPHEMERIS AND NAUTICAL
ALMANAC FOR 1855.

DIRECTIONS

FOR USING

THE TABLES FOR CORRECTING LUNAR DISTANCES.

THE object of these Tables is to give the *true* correction of a lunar distance in all cases when, with the apparent distance of the moon from the sun, a planet, or star, the apparent altitudes of the two objects have also been obtained by observation. They enable us readily to take into account, — 1st, the parallax of the moon in the latitude of the observer, allowing for the spheroidal figure of the earth; 2d, the parallax of the sun or a planet; 3d, the true atmospheric refraction, allowing for the actual state of the air as shown by the barometer and thermometer; and 4th, that effect of refraction which gives the apparent discs of the moon and sun an oval or elliptical figure.

The longitude deduced from a lunar observation, when no attention is paid to the spheroidal figure of the earth, to the barometer and thermometer, and the elliptical figure of the discs, may in certain cases be in error *a whole degree*. It is true these extreme cases are rare in practice; but cases are common in which from such neglect the error in the longitude is 10', 15', or 20'. Since lunars are now chiefly valuable as checks upon the chronometer, it is absolutely necessary to get rid of such errors, and to leave no other inaccuracy in the result than that which unavoidably follows from the observations. This is accomplished by means of these Tables, with an amount of labor very little greater than that which is required by the inaccurate methods in common use.

THE OBSERVATION.

The record of a *complete* observation embraces, —

1. The latitude and approximate longitude of the place of observation.
2. The approximate local time.
3. The time of observation as shown by a chronometer, and the error of the chronometer, or its difference from mean Greenwich time.
4. The apparent distance of the moon's bright limb from a star or planet, or from the nearest limb of the sun.
5. The apparent altitude of the moon's upper or lower limb above the sea horizon.
6. The apparent altitude of the star, planet, or lower limb of the sun above the sea horizon.

CORRECTION OF

7. The height of the barometer and thermometer.
8. The height of the eye above the level of the sea.
9. The index correction of the sextant, if a sextant is used.

The index correction of the sextant may be supposed to be previously determined, but, since even in the best instruments it is not constant, its determination should be considered a necessary part of the observation; and when the greatest precision is sought, it should be found both before and after the measurement of the distance, and its mean value taken.

The error of the chronometer above alluded to is that which is obtained by applying the daily rate (multiplied by the proper number of days) to the error found before leaving port. The agreement or disagreement of the error thus found with that found by the lunar observation will be the test of the good or bad going of the chronometer.

PREPARATION OF THE DATA.

Greenwich Date. — Correct the chronometer time for its error from Greenwich time and deduce the Greenwich Date, i. e. the Greenwich day and hour (mean time), reckoning the hours in succession from 0 to 24, beginning at noon.

Nautical Almanac. — With the Greenwich Date enter the Almanac and take out the moon's semidiameter and horizontal parallax; and if the sun is observed, its semidiameter and horizontal parallax; * but if a planet is observed, its horizontal parallax only.

Apparent Altitude of the Moon. — To the altitude given by the sextant apply the index correction of the instrument and subtract the dip of the horizon, Table I. If the lower limb is observed, add the semidiameter augmented by Table II.; if the upper limb is observed, subtract the augmented semidiameter. The result is the apparent altitude of the moon's centre, denoted "*☾*'s *App. Alt.*"

Apparent Altitude of the Sun, Planet, or Star. — To the observed altitude apply the index correction of the sextant, and subtract the dip, Table I.; and if the sun is used, add its semidiameter when the lower limb is observed, or subtract it when the upper limb is observed. The result is the apparent altitude required, denoted by "*☉*'s or *✴*'s *App. Alt.*"

Apparent Distance. — 1st. When the sun is used, to the observed distance (corrected for index error when necessary) add the moon's augmented semidiameter and the sun's semidiameter. 2d. When a planet or star is used, add the moon's augmented semidiameter if its nearest limb is observed, but subtract it if its farthest limb is observed. The result is "*App. Dist.*"

Moon's Reduced Parallax and Refraction. — Enter Table III. with the latitude of the place of observation and the moon's horizontal parallax, and take out the correction, which add to the horizontal parallax. Call the result the moon's reduced parallax, or "*☾*'s *Red. P.*"

Enter Table IV. with the moon's apparent altitude, and take out the mean reduced

* The sun's horizontal parallax may be assumed as 8".5.

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refraction, and apply to this mean refraction the corrections given in Tables IV. A. and IV. B., adding or subtracting these corrections according to the directions in the Tables. The result is the moon's reduced refraction or " $\odot$'s *Red. R.*"

Subtract the " $\odot$'s *Red. R.*" from the " $\odot$'s *Red. P.*" and mark the result as " $\odot$'s *Red. P. and R.*"

*Reduced Parallax and Refraction of Sun, Planet, or Star.** — With the apparent altitude of the sun, planet, or star, take from Table IV. the mean reduced refraction, which correct by Tables IV. A. and IV. B. If the sun is observed, subtract its horizontal parallax (which may be always taken at $8''.5$) from its reduced refraction, and mark the result as " $\odot$'s *Red. P. & R.*" If a planet is observed subtract its horizontal parallax, and mark the result as " $\star$'s *Red. P. & R.*" If a star is observed its reduced refraction is at once the required " $\star$'s *Red. P. & R.*"

COMPUTATION OF THE TRUE DISTANCE.

Take from Table V. the four logarithms A, B, C, D ,† and place these logs. each at the head of a column, marking the columns A, B, C , and D , respectively; then put the

log. of $\odot$'s <i>Red. P. & R.</i>	(Table IX.)	in Columns A and B
log. of $\odot$'s <i>Red. P. & R.</i>	"	" C " D
log. sine $\odot$'s <i>App. Alt.</i>	(Bowd. Table XXVII.)	" A " D
log. sine $\odot$'s <i>App. Alt.</i>	"	" B " C
log. cotangent <i>App. Dist.</i>	"	" A " C
log. cosecant <i>App. Dist.</i>	"	" B " D .

The sum of the four logs. in Col. A is the log. (Table IX.) of the *First Part of $\odot$'s Correction*, which is to be marked $+$ when the *App. Dist.* is less than 90° , but $-$ when the *App. Dist.* is greater than 90° .

The sum of the four logs. in Col. B is the log. (Table IX.) of the *Second Part of $\odot$'s Correction*, which is always to be marked $-$.

The sum of the four logs. in Col. C is the log. (Table IX.) of the *First Part of the $\star$'s or $\odot$'s Correction*, which is to be marked $-$ when the *App. Dist.* is less than 90° , but $+$ when the *App. Dist.* is greater than 90° .

The sum of the four logs. in Col. D is the log. (Table IX.) of the *Second Part of the $\star$'s or $\odot$'s Correction*, which is always to be marked $+$.

Combine the first and second parts of the $\odot$'s correction according to the signs ($+$ or $-$) prefixed; that is, take their *sum* if they have the *same* sign, but their *difference* if they have *different* signs, and prefix the sign of the greater to the result, which call " $\odot$'s *whole Correction.*"

In the same manner form the $\star$'s or $\odot$'s *whole Correction.*

First Correction of Distance. — Combine the $\odot$'s *whole corr.* and the $\star$'s

* The parallax of a star being zero, its "reduced parallax and refraction" become, of course, merely its "reduced refraction"; but as no mistake can arise from marking it as " $\star$'s *P. & R.*," this designation has been retained in order to give simplicity and uniformity at once to the rules and the tables.

† No interpolation is required in taking out these logarithms.

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whole corr. according to their signs; the result is the *First Correction of Distance*, which is to be added to or subtracted from the apparent distance, according as its sign is + or —.

Second Correction of Distance. — Enter Table VI. with the Apparent Distance and the First Correction of Distance, and take out the *Second Correction of Distance*, which is to be applied to the distance according to the directions in the side columns of the Table.

Correction for the Elliptical Figure of the Moon's Disc, or Contraction of the Moon's Semidiameter (Table VII.). — Enter Table VII. A. with the ☾'s App. Alt. and ☾'s Red. P. & R., and take out the number. With this number and the ☾'s whole correction enter Table VII. B. and take the required *contraction*, which is to be *added* to the App. Dist. when the *farthest* limb is observed, but *subtracted* when the *nearest* limb is observed.

Correction for the Elliptical Figure of the Sun's Disc, or Contraction of the Sun's Semidiameter (Table VIII.). — Enter Table VIII. A. with the ☉'s App. Alt. and ☉'s Red. P. & R. and take out the number. With this number and the ☉'s whole corr. enter Table VIII. B. and take out the required *contraction*, which is always to be *subtracted* from the distance (the *nearest* limb of the sun being always observed).

Correction for Compression or for the Spheroidal Figure of the Earth. — Take from the Nautical Almanac for the Greenwich Date the value of $\log. N$, given with the lunar distance observed.* To $\log. N$ add the $\log.$ sine of the latitude of the place of observation; the sum is the $\log.$ (Table IX.) of the required *correction for compression*. In North latitude *add* this correction to the distance if $\log. N$ in the Nautical Almanac is marked +, or *subtract* it if $\log. N$ is marked —; in South latitude subtract the correction when $\log. N$ is +, and add it when $\log. N$ is —.

All these corrections being applied to the Apparent Distance, the result is the *True Distance*.

TO FIND THE ERROR OF THE CHRONOMETER.

Find in the Nautical Almanac the two distances between which the true distance falls. Take out the first of these together with the Prop. Log. following it and the hours of Greenwich time over it. Find the difference between the distance taken from the Almanac and the true distance, and to the $\log.$ of this difference (Table IX.) *add* the Prop. Log. from the Almanac; the sum is the $\log.$ (Table IX.) of an interval

* The values of $\log. N$ are no longer given in the Nautical Almanac. For distances of the moon from the sun for the year 1855, they are given in Table XI. of this volume. For other distances, at any time, $\log. N$ may be found from Table XII. by the following rule:

From the Nautical Almanac take the moon's and star's (or planet's) declinations to the nearest whole degree. With the moon's declination and apparent distance take from Table XII. A. the *first part of N*, and mark it with the sign in the table if the declination is *North*; but if the declination is *South*, change the sign from + to — or from — to +. With the star's (or planet's) declination and apparent distance, take from Table XII. B. the *second part of N*, and mark it + when the declination is *North*, and — when *South*. Take the *sum*, or *difference*, of the two parts, according as their signs are the *same* or *different*, and to the resulting number prefix the sign of the greater. The logarithm of this number of seconds, taken in Table IX., with its sign prefixed, is the required $\log. N$, to be used as directed in the text.

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of time to be added to the hours of Greenwich time taken from the Almanac. The result is the *approximate* Greenwich time.

To correct this Greenwich time, take the difference between the two Prop. Logs. in the Almanac which stand against the two distances between which the true distance falls. With this difference and the interval of time just found, enter Table X. of this Appendix, and take out the seconds, which are to be *added* to the approximate Greenwich time when the Prop. Logs. are *decreasing*, but *subtracted* when the Prop. Logs. are *increasing*. The result is the *true Greenwich time*.

The difference between the true Greenwich time and the time shown by the chronometer is the error of the chronometer as determined by the lunar observation.

DEGREE OF DEPENDENCE.

If the error thus determined agrees with that deduced by means of the rate and original error, the chronometer has run well, and its rate is confirmed; if otherwise, more or less doubt is thrown upon the chronometer, according to the degree of accuracy of the lunar observation itself. An error of $10''$ in the measurement of the distance produces about 20^s error in the Greenwich time; and since, even with the best observers, a single set of distances is subject to a possible error of $10''$, it may be well to consider the chronometer as still to be trusted so long as it does not differ from the lunar by more than 20^s . Since, however, so much depends upon skill in measuring the distance, the observer can only form a correct judgment of the degree of dependence to be placed upon his own observations by repeated trials and a careful comparison of his several results.

CORRECTION OF

EXAMPLE I.

In Lat. $35^{\circ} 30' N.$, Long. $30^{\circ} W.$, by account, on September 7th, 1855, about 6^{*a*} A. M., the Greenwich chronometer showing $8^h 29^m 57^s.5$ and supposed to be *fast* $21^m 1^s.5$; the observed distance of $\odot$'s and ζ 's nearest limbs is $43^{\circ} 52' 10''$; observed alt. ζ $49^{\circ} 32' 50''$; observed alt. $\odot$ $5^{\circ} 27' 10''$; barometer 29.1 inches, thermometer 75° ; height of the eye above the sea 20 feet; index correction of the sextant 0. What is the error of the chronometer on Greenwich time according to these observations?

Preparation of the Data.

Chronometer	$8\ 29\ 57.5$	ζ 's semid. N. A.	$14\ 50.0$	ζ 's Par. N. A.	$54\ 19.4$
(Fast)	$-21\ 1.5$	Aug. Tab. II.	$+11.2$	Aug. Tab. III.	$+3.6$
Greenw. date Sept. 6	$20\ 8\ 56.0$	ζ 's aug. Semid.	$15\ 1.2$	ζ 's Red. P.	$54\ 23.0$
Obs'd Alt. ζ	$49\ 32\ 50$	Obs'd alt. $\odot$	$5\ 27\ 10$	Obs'd distance $\odot \zeta$	$43\ 52\ 10$
Dip Tab. I.	$-4\ 23$	Dip	$-4\ 23$	ζ 's aug. semid.	$+15\ 1$
ζ 's aug. semid.	$+15\ 1$	$\odot$'s semid	$+15\ 55$	$\odot$'s semid.	$+15\ 55$
ζ 's App. Alt.	$49\ 43\ 28$	$\odot$'s App. Alt.	$5\ 30\ 42$	App. Dist.	$44\ 23\ 6$
ζ 's Red. R. Tab. IV.	$1\ 16$	$\odot$'s Red. R. Tab. IV.	$8\ 57$		
Barom. Tab. IV. A.	-3	Barom. Tab. IV. A.	-16		
Therm. Tab. IV. B.	-4	Therm. Tab. IV. B.	-28		
ζ 's Red. R.	$1\ 9$	$\odot$'s Red. R.	$8\ 13$		
ζ 's Red. P.	$54\ 23$	$\odot$'s Par.	8		
ζ 's Red. P. & R.	$53\ 14$	$\odot$'s Red. P. & R.	$8\ 5$		

Computation of the True Distance.

A.		C.			
log. A. Tab. V.	0.0021	log. C. Tab. V.	9.9949		
log. ζ 's Red. P. & R. Tab. IX.	3.5043	log. $\odot$'s Red. P. & R. Tab. IX.	2.6857		
log. sin. ζ 's App. Alt.	9.8825	log. sin. $\odot$'s App. Alt.	8.9929		
log. cot. App. Dist.	0.0093	log. cot. App. Dist.	0.0093		
{ log. Tab. IX.	3.3982	{ log. Tab. IX.	1.6828		
{ 1st Part ζ 's corr.	$+41' 42''$	{ 1st Part $\odot$'s corr.	$-0' 48''$		
B.		D.			
log. B. Tab. V.	9.9951	log. D. Tab. V.	9.9992		
log. ζ 's Red. P. & R.	3.5043	log. $\odot$'s Red. P. & R.	2.6857		
log. sin. $\odot$'s App. Alt.	8.9929	log. sin. ζ 's App. Alt.	9.8825		
log. cosec. App. Dist.	0.1552	log. cosec. App. Dist.	0.1552		
{ log. Tab. IX.	2.6475	{ log. Tab. IX.	2.7226		
{ 2d Part ζ 's corr.	$-7' 24''$	{ 2d Part $\odot$'s corr.	$+8' 48''$	App. Dist.	$44\ 23\ 6$
ζ 's whole corr.	$+34' 18''$	$\odot$'s whole corr.	$+8' 0''$	1st corr.	$+42\ 18$
				2d corr. Tab. VI	-16
				Contraction of ζ 's	0
				Semid. Tab. VII.	
				Contraction of $\odot$'s	-20
				Semid. Tab. VIII.	
log. N.* Tab. XI.	-0.764			Corr. for compression	-3
log. sin. Lat. $35^{\circ} 30' N.$	$+9.764$			True Distance	$45\ 4\ 45$
log. Tab. IX.	-0.528				

* This log. may also be found from Table XII. by the rule in the note on p. 8.

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To find the Error of the Chronometer.

True distance	45° 4' 45"		
Distance N. A. at XVIII. ^h	46 3 17	P. L.	0.3433
Difference	58 32	log. Tab. IX.	3.5456
Approximate interval	2 ^h 9 ^m 3 ^s	log. Tab. IX.	3.8889
Add	18		
Approx. Gr. time	20 9 3		
Corr. Tab. X.	—2		
True Gr. time	20 9 1		
Gr. time by Chronom.	20 8 56		
Chronom. and lunar differ only	5		

and therefore the chronometer may be considered as going well.

This example, worked by Bowditch's First Method, gives the true distance 45° 5' 44", differing from the above 59", in consequence of the omission by Bowditch of the small corrections. This difference would produce an error of 2^m 10" in the Greenwich time, and consequently the longitude in this case deduced by Bowditch's method would be in error 32'.5; that is, *more than half a degree*.

EXAMPLE II.

In Lat. 55° 20' S., Long. 120° 25' W., by account, on August 29th, 1855, about 9^h 40^m P. M., the Greenwich chronometer showing 5^h 35^m 46^s.2 and from previous rate supposed *slow* 5^m 12^s; the following distance and altitudes are found, being the mean of six observations corrected for index errors. Observed distance of Fomalhaut and ϵ 's farthest limb 46° 30' 23"; observed alt. ϵ 6° 26' 10"; observed alt. Fomalhaut 52° 34' 40"; barometer 31 inches; thermometer 20°; height of the eye above the sea 18 feet. What is the error of the chronometer according to these observations?

Preparation of the Data.

Chronometer	h. m. s.	ϵ 's semid. N. A.	16 26.3	ϵ 's Par. N. A.	60 11.8
(Slow)	+ 5 12	Aug. Tab. II.	+2.0	Aug. Tab. III.	+8.3
Greenw. date Aug. 29 ^d	17 40 58.2	ϵ 's aug. Semid.	16 28.3	ϵ 's Red. P.	60 20.1
Obs'd Alt. ϵ	6 26 10	Obs'd alt. *	52 34 40	Obs'd distance * ϵ	46 30 23
Dip Tab. I.	— 4 9	Dip	— 4 9	ϵ 's aug. semid.	— 16 28
ϵ 's aug. semid.	+16 28	*'s App Alt.	52 30 31	App. Dist.	46 13 55
ϵ 's App. Alt.	6 38 29				
ϵ 's Red. R. Tab. IV.	7 48	*'s Red. R. Tab. IV.	1 13		
Barom. Tab. IV. A.	+16	Barom. Tab. IV. A.	+ 2		
Therm. Tab. IV. B.	+32	Therm. Tab. IV. B.	+ 5		
ϵ 's Red. R.	8 36	*'s Red. R.	1 20		
ϵ 's Red. P.	60 20	*'s Par.	0		
ϵ 's Red. P. & R.	51 44	*'s Red. P. & R.	1 20		

CORRECTION OF LUNAR DISTANCES.

Computation of the True Distance.

A.		C.	
log. A. Tab. V.	0.0274	log. C. Tab. V.	9.9999
log. ζ 's Red. P. & R. Tab. IX.	3.4919	log. $\star$'s Red. P. & R. Tab. IX.	1.9031
log. sin. ζ 's App. Alt.	9.0632	log. sin. $\star$'s App. Alt.	9.8995
log. cot. App. Dist.	9.9813	log. cot. App. Dist.	9.9813
{ log. Tab. IX.	2.5638	{ log. Tab. IX.	1.7838
{ 1st Part ζ 's corr.	+6' 6"	{ 1st Part $\star$'s corr.	-1' 1"
B.		D.	
log. B. Tab. V.	0.0001	log. D. Tab. V.	0.0267
log. ζ 's Red. P. & R.	3.4919	log. $\star$'s Red. P. & R.	1.9031
log. sin. $\star$'s App. Alt.	9.8995	log. sin. ζ 's App. Alt.	9.0632
log. cosec. App. Dist.	0.1414	log. cosec. App. Dist.	0.1414
{ log. Tab. IX.	3.5329	{ log. Tab. IX.	1.1344
{ 2d Part ζ 's corr.	-56' 51"	{ 2d Part $\star$'s corr.	+0' 14"
ζ 's whole corr.	-50' 45"	$\star$'s whole corr.	-0' 47"
log. N.*	-1.230		
log. sin. Lat. 55° S.	-9.913		
log. Tab. IX.	+1.143		
			App. Dist. 46° 13' 55"
			1st corr. -51' 32"
			2d corr. Tab. VI. - 22"
			Contraction of ζ 's } + 17"
			Semid. Tab. VII. }
			Corr. for compression + 14"
			True Distance 45° 22' 32"

To find the Error of the Chronometer.

True Distance	45° 22' 32"	P. L.	0.2527	Diff. P. Logs. -8
Dist. N. A. at XV. ^h	43 51 59	log. Tab. IX.	3.7350	
Difference	1 30 33	log. Tab. IX.	3.9877	
Approx. interval	2 ^h . 42 ^m . 1 ^s .			
Add	15			
Approx. Gr. time	17 42 1			
Corr. Tab. X.	+1			
True Gr. time	17 42 2			
Gr. time by chronom.	17 40 58			
Chron. and lunar differ	1 4			

and, the distances having been observed with care, the chronometer has probably changed its rate. A second observation confirming this, we must, from repeated lunars, determine a new rate, which may be used until an opportunity occurs of rating at a fixed place whose longitude is tolerably well known.

This example, worked by Bowditch's Second Method, gives the true distance 45° 21' 31", which is in error 1' 1", and would produce in the longitude deduced from it in this case an error of about 28'.

* This value of log. N. is formed from Tab. XII. by the rule in the note on page 8 of this Appendix: thus

$$\begin{aligned} \zeta \text{'s dec. } 4^\circ \text{ N., App. Dist. } 46^\circ \text{ in Tab. XII. A. gives 1st Part of N } -1'' \\ \star \text{'s dec. } 30^\circ \text{ S., App. Dist. } 46^\circ \text{ in Tab. XII. B. gives 2d Part of N } -16 \\ \text{N } -17 \end{aligned}$$

the log. of which is in Tab. IX. 1.230.

EXPLANATION OF THE TABLES.*

TABLE I. — *Dip of the Sea Horizon*, computed by Delambre's formula (*Astronomie*, Vol. III., Chap. XXXVI.), which, when feet are substituted for metres, is

$$D = 58''.8 \sqrt{F},$$

where F = height of the eye above the level of the sea, in feet,

D = depression of the sea horizon, in seconds.

TABLE II. — *Augmentation of the Moon's Semidiameter*, computed by the formula (Francœur, *Astron. Pratique*, p. 58)

$$x = c s^2 \sin h + \frac{1}{2} c^2 s^3 \sin^2 h + \frac{1}{2} c^2 s^3,$$

where h = moon's apparent altitude,

s = moon's horizontal semidiameter,

x = augmentation of semidiameter for the altitude h ,

$\log c = 5.25021$.

TABLE III. — *Augmentation of the Moon's Horizontal Parallax*, or correction to reduce the moon's equatorial horizontal parallax to that point of the earth's axis which lies in the vertical of the observer in any given latitude, computed by the formulas

$$\Delta \pi = \pi (b - 1), \quad b = \frac{1}{\sqrt{(1 - e^2 \sin^2 \phi)}},$$

where π = equatorial horizontal parallax,

ϕ = latitude,

e = eccentricity of the meridian, $\log e^2 = 7.81602$,

$\Delta \pi$ = augmentation of the horizontal parallax for the latitude ϕ .

TABLE IV. — *Mean Reduced Refraction for Lunars*, computed by the formula

$$r' = \frac{r}{\cos h} = \frac{k}{\sin h},$$

* Tables I., II., and IX., which are not peculiar to my method, are inserted to save a reference to other works for them; so that the computer requires, in connection with this volume, only a table of logarithmic sines and tangents. These three tables have, however, been recomputed, as stated in the "Explanation."

EXPLANATION

where h = the apparent altitude,

r = mean refraction, barometer 30 inches, Fahrenheit's thermometer 50°,

r' = mean reduced refraction for lunars.

The refractions employed are BESSEL'S, and were taken from his table (*Astronomische Untersuchungen*, Vol. I. p. 200), which gives directly $K = r \tan h$.

TABLES IV. A. AND IV. B. — *Corrections of the Mean Refraction for the Height of the Barometer and Thermometer*, deduced also from Bessel's table above cited. These tables serve for correcting either r or r' , according as the one or the other is taken as the argument.

TABLE V. — *Logs. of A, B, C, and D, for computing the First Correction of the Lunar Distance*, computed by the formulas

$$A = K^2 \frac{\sin(h + \frac{1}{2} \Delta h)}{\sin h}, \quad C = \frac{\sin(H - \Delta H)}{\sin H},$$

$$B = K' \frac{\sin(2H - \Delta H)}{\sin 2H}, \quad D = \frac{\sin(2h + \Delta h)}{\sin 2h},$$

where h = moon's apparent altitude,

H = sun's, planet's, or star's apparent altitude (denoted in the tables by $\odot$'s or $\star$'s App. Alt.),

Δh = difference of $\odot$'s apparent and true altitudes,

ΔH = difference of $\odot$'s or $\star$'s apparent and true altitudes,

$\log K' = .000126$,

and $\Delta h, \Delta H$ were computed from the arguments "apparent altitude" and "reduced parallax and refraction" by the formulas

$$\Delta h = (p - r') K' \cos h, \quad \Delta H = (R' - P) \cos H,$$

where $p - r' = \odot$'s reduced parallax and refraction,

$R' - P = \odot$'s or $\star$'s reduced parallax and refraction,

$p = \odot$'s horizontal parallax $+ \Delta \pi$ (Table III.),

$P = \odot$'s or $\star$'s horizontal parallax (for a star $P = 0$),

$r' = \odot$'s reduced refraction (Table IV.),

$R' = \odot$'s or $\star$'s reduced refraction (Table IV.).

When h and H become 90°, the values of B and D assume the indeterminate forms

$$B = \frac{0}{0}, \quad D = \frac{0}{0},$$

and therefore, for computing their logarithms near the end of the table, the formulas were transformed as follows:

$$B = C K' [1 + \frac{1}{2} (R' - P) \sin 1'' \sin H],$$

$$D = \frac{A}{K'} [1 - \frac{1}{2} (p - r') K' \sin 1'' \sin h].$$

By means of Logs. A, B, C , and D , the first correction of the distance is found by the following formulas: —

if

$$\begin{aligned} d &= \text{apparent distance of } \mathfrak{C} \text{ from } \odot \text{ or } *, \\ \Delta_1 d &= \text{first correction,} \\ A' &= A (p - r') \sin h \cot d, \\ B' &= -B (p - r') \sin H \operatorname{cosec} d, \\ C' &= -C (R' - P) \sin H \cot d, \\ D' &= D (R' - P) \sin h \operatorname{cosec} d, \end{aligned}$$

then

$$\Delta_1 d = (A' + B') + (C' + D'),$$

and in the directions for using the tables, $A' + B'$ is called the “whole correction for $\mathfrak{C}$,” and $C' + D'$ the “whole correction for $\odot$ or $*$.”

TABLE VI. — *Second Correction of the Lunar Distance*, computed by the formula

$$\Delta_2 d = -\frac{1}{2} \Delta_1 d^2 \sin 1'' \cot d.$$

Strictly, this formula should be

$$\Delta_2 d = -\frac{1}{2} \Delta d^2 \sin 1'' \cot d,$$

where $\Delta d =$ whole correction of distance $= \Delta_1 d + \Delta_2 d$, so that by entering the table first with $\Delta_1 d$ we find only an approximate value of $\Delta_2 d$. But if with this approximate value we form the approximate whole correction $\Delta_1 d + \Delta_2 d$, and enter with this as the argument in the place of $\Delta_1 d$, we have the true value of $\Delta_2 d$. It is evident, however, from the table itself, that, in most practical cases, this degree of precision is unnecessary.

TABLE VII. — *For finding the Correction of the Lunar Distance for the Contraction of the Moon's Semidiameter* (by refraction), computed by the formula

$$\Delta s = \Delta s_0 \frac{(A' + B')^2}{(p - r')^2 \cos^2 h}$$

where the notation already employed is preserved, and

$\Delta s_0 =$ contraction of the moon's vertical semidiameter at the altitude h ,

$\Delta s =$ contraction of the inclined semidiameter, or of that which lies in the direction of the lunar distance.

This table is subdivided into Tables VII. A. and VII. B. If we put

$$g = \frac{\Delta s_0}{(p - r')^2 \cos^2 h} \times f,$$

then

$$\Delta s = (A' + B')^2 \times \frac{g}{f},$$

where f is an arbitrary factor employed to give g convenient integral values, and in these tables we have taken $f = 18000000$; Δs_0 , Δs , $p - r'$, and $A' + B'$ being all expressed in seconds. Table VII. A. gives the value of g with the arguments $p - r'$ and h ; and Table VII. B. gives Δs with the arguments $A' + B'$ and g .

To find Δs_0 from the arguments $p - r'$ and h , the mean value of r' for the altitude h was added to $p - r'$, so that p became known; whence also the semidiameter, —

EXPLANATION

and consequently, by means of the refraction tables, the contraction Δs_0 . The value of Δs given by Table VII. B. is therefore that which corresponds to a mean state of the air, and in *extreme* cases may be in error $4''$, but in no *probable* case will it be in error more than $1''$. The true value of Δs might, however, always be found by correcting it, as refraction, by Tables IV. A. and IV. B.

TABLE VIII. — *For finding the Correction of the Lunar Distance for the Contraction of the Sun's Semidiameter* (by refraction), computed by the formula

$$\Delta S = \Delta S_0 \frac{(C' + D')^2}{(R' - P)^2 \cos^2 H},$$

where, in addition to the notation already employed, ΔS_0 = contraction of the sun's vertical semidiameter at the altitude H ; ΔS = contraction of the inclined semidiameter. Table VIII. A., with the arguments $R' - P$ and H , gives a number

$$G = \frac{(R' - P)^2 \cos^2 H}{\Delta S_0} \times F,$$

in which ΔS_0 is taken for a mean value of the sun's semidiameter, P is assumed at $8''.5$, and F is an arbitrary factor = $\frac{1}{200}$; $R' - P$, $C' + D'$, ΔS_0 , and ΔS being all expressed in seconds. Table VIII. B., with the arguments $C' + D'$ and G , gives

$$\Delta S = (C' + D')^2 \times \frac{F}{G}.$$

This value of ΔS is that which belongs to the actual state of the air, but is for a mean value of the sun's semidiameter, the variations of which would not change the tabular value by more than $0''.5$ in any case.

TABLE IX. — *Logarithms of Seconds*. This table contains the common logarithm answering to the arc (either space or time) in the argument. For the convenience of the navigator, this table is given with the argument, degrees, minutes, and seconds, or hours, minutes, and seconds, for every ten seconds, at the side, the unit figure of the seconds being found at the top.

The logarithm is given with the proper characteristic prefixed.

TABLE X. — This table contains the correction for second differences of the moon's motion.

TABLE XI. contains the values of $\log. N$ for the distances from the sun, computed by the following formula: —

$$N = N' \pi \left(\frac{\sin \Delta}{\sin d} - \frac{\sin \delta}{\tan d} \right);$$

where π = $\odot$'s equatorial horizontal parallax,

Δ = sun's declination,

δ = $\odot$'s declination,

d = angular distance of the moon and sun referred to the centre of the earth,

$N' = \frac{\epsilon^2}{\sqrt{(1 - \epsilon^2 \sin^2 \phi)}}$, for which the value of N' is taken corresponding to

$\phi = 45^\circ$, or $\log. N' = 7.8170$.

OF THE TABLES.

TABLE XII. — *For finding the Value of N.* By this table an approximate value of N may be readily found, with sufficient accuracy for ordinary purposes. When very great accuracy is desired, the formula given in the explanation of Table XI. should be used. In Table XII. the moon's horizontal parallax is assumed at its mean value = $57' 30''$, and the two parts of N are separately tabulated by the formulas

$$a (= \text{first part of } N) = - N \pi \sin \delta \cotan d,$$

$$b (= \text{second part of } N) = N \pi \sin \Delta \operatorname{cosec} d;$$

from which N is found by the formula

$$N = a + b.$$

NOTE. — The demonstration of most of the formulas cited in the preceding explanation is given in the *Astronomical Journal* (Cambridge, Mass.), Vol. II., Nos. 3 and 4.

TABLES.

TABLE I.			TABLE II.								TABLE III.			
Dip of the Sea Horizon.			Augmentation of the Moon's Semidiameter.								Augmentation of the Moon's Hor. Parallax.			
Height of the Eye.	Dip of the Horizon.	Appar- ent Altitude of D.	D's Semidiameter.						Latitude of Ob- servation.	D's Horizontal Parallax.				
			14'	15'		16'		17'		53'	57'	61'		
			30"	0"	30"	0"	30"	0"						
Feet.	' "	°	"	"	"	"	"	"	°	"	"	"		
0	0 00	0	0.1	0.1	0.1	0.1	0.2	0.2	0	0.0	0.0	0.0		
1	0 59	2	0.6	0.6	0.7	0.7	0.8	0.8	2	0.0	0.0	0.0		
2	1 23	4	1.0	1.1	1.2	1.3	1.4	1.5	4	0.1	0.1	0.1		
3	1 42	6	1.5	1.6	1.7	1.9	2.0	2.1	6	0.1	0.1	0.1		
4	1 58	8	2.0	2.1	2.3	2.4	2.6	2.7	8	0.2	0.2	0.2		
5	2 11	10	2.4	2.6	2.8	3.0	3.2	3.4	10	0.3	0.3	0.4		
6	2 24	12	2.9	3.1	3.3	3.6	3.8	4.0	12	0.5	0.5	0.5		
7	2 36	14	3.4	3.6	3.9	4.1	4.4	4.7	14	0.6	0.7	0.7		
8	2 46	16	3.8	4.1	4.4	4.7	5.0	5.3	16	0.8	0.9	0.9		
9	2 56	18	4.3	4.6	4.9	5.2	5.6	5.9	18	1.0	1.1	1.1		
10	3 06	20	4.7	5.1	5.4	5.8	6.1	6.5	20	1.2	1.3	1.4		
11	3 15	22	5.2	5.5	5.9	6.3	6.7	7.1	22	1.5	1.6	1.7		
12	3 24	24	5.6	6.0	6.4	6.8	7.3	7.7	24	1.7	1.9	2.0		
13	3 32	26	6.0	6.5	6.9	7.4	7.8	8.3	26	2.0	2.2	2.3		
14	3 40	28	6.5	6.9	7.4	7.9	8.4	8.9	28	2.3	2.5	2.6		
15	3 48	30	6.9	7.3	7.9	8.4	8.9	9.5	30	2.6	2.8	3.0		
16	3 55	32	7.3	7.8	8.3	8.9	9.4	10.0	32	2.9	3.1	3.4		
17	4 02	34	7.7	8.2	8.8	9.4	10.0	10.6	34	3.3	3.5	3.8		
18	4 09	36	8.1	8.6	9.2	9.8	10.5	11.1	36	3.6	3.9	4.1		
19	4 16	38	8.4	9.0	9.7	10.3	10.9	11.6	38	4.0	4.3	4.6		
20	4 23	40	8.8	9.4	10.1	10.7	11.4	12.1	40	4.3	4.6	5.0		
21	4 29	42	9.2	9.8	10.5	11.2	11.9	12.6	42	4.7	5.0	5.4		
22	4 36	44	9.5	10.2	10.9	11.6	12.3	13.1	44	5.0	5.4	5.8		
23	4 42	46	9.8	10.5	11.3	12.0	12.8	13.6	46	5.4	5.8	6.2		
24	4 48	48	10.2	10.9	11.6	12.4	13.2	14.0	48	5.8	6.2	6.6		
25	4 54	50	10.5	11.2	12.0	12.8	13.6	14.4	50	6.1	6.6	7.1		
26	5 00	52	10.8	11.5	12.3	13.1	14.0	14.9	52	6.5	7.0	7.5		
27	5 06	54	11.1	11.8	12.7	13.5	14.4	15.3	54	6.8	7.4	7.9		
28	5 11	56	11.3	12.1	13.0	13.8	14.7	15.6	56	7.2	7.7	8.3		
29	5 17	58	11.6	12.4	13.3	14.1	15.1	16.0	58	7.5	8.1	8.6		
30	5 22	60	11.8	12.7	13.5	14.4	15.4	16.3	60	7.8	8.4	9.0		
35	5 48	62	12.1	12.9	13.8	14.7	15.7	16.6	62	8.1	8.8	9.4		
40	6 12	64	12.3	13.2	14.1	15.0	16.0	16.9	64	8.4	9.1	9.7		
45	6 34	66	12.5	13.4	14.3	15.2	16.2	17.2	66	8.7	9.4	10.0		
50	6 56	68	12.7	13.6	14.5	15.5	16.5	17.5	68	9.0	9.7	10.3		
55	7 16	70	12.9	13.8	14.7	15.7	16.7	17.7	70	9.2	9.9	10.6		
60	7 35	72	13.0	13.9	14.9	15.9	16.9	17.9	72	9.5	10.2	10.9		
65	7 54	74	13.1	14.1	15.0	16.0	17.1	18.1	74	9.7	10.4	11.1		
70	8 12	76	13.3	14.2	15.2	16.2	17.2	18.3	76	9.8	10.6	11.3		
75	8 29	78	13.4	14.3	15.3	16.3	17.4	18.4	78	10.0	10.8	11.5		
80	8 46	80	13.5	14.4	15.4	16.4	17.5	18.6	80	10.1	10.9	11.7		
85	9 02	82	13.5	14.5	15.5	16.5	17.6	18.7	82	10.3	11.0	11.8		
90	9 18	84	13.6	14.6	15.6	16.6	17.6	18.7	84	10.3	11.1	11.9		
95	9 33	86	13.6	14.6	15.6	16.6	17.7	18.8	86	10.4	11.2	12.0		
100	9 48	88	13.7	14.6	15.6	16.7	17.7	18.8	88	10.4	11.2	12.0		
		90	13.7	14.6	15.6	16.7	17.7	18.8	90	10.5	11.3	12.0		

TABLE IV.

Mean *Reduced Refraction* for *Lunars*. Barometer 30 inches. Fahrenheit's Thermometer 50°.

Apparent Altitude.	Reduced Refraction.	Diff. to μ .	Apparent Altitude.	Reduced Refraction.	Apparent Altitude.	Reduced Refraction.	Apparent Altitude.	Reduced Refraction.
0 1	9 54.2	1.6	10 0	5 24.1	15 0	3 41.7	27 0	2 7.8
5 5	9 46.3	1.5	5 5	5 21.6	10 10	3 39.4	27 30	2 5.7
10 9	9 38.6	1.5	10 5	5 19.2	20 3	3 37.1	28 0	2 3.7
15 9	9 31.0	1.5	15 5	5 16.8	30 3	3 34.9	28 30	2 1.7
20 9	9 23.7	1.4	20 5	5 14.4	40 3	3 32.7	29 0	1 59.8
25 9	9 16.5	1.4	25 5	5 12.1	50 3	3 30.6	29 30	1 58.0
5 30	9 9.5	1.4	10 30	5 9.8	16 0	3 28.5	30 0	1 56.2
35 9	9 2.7	1.3	35 5	5 7.5	10 3	3 26.5	30 30	1 54.5
40 8	8 56.0	1.3	40 5	5 5.3	20 3	3 24.5	31 0	1 52.8
45 8	8 49.5	1.3	45 5	5 3.1	30 3	3 22.6	31 30	1 51.2
50 8	8 43.1	1.2	50 5	5 0.9	40 3	3 20.7	32 0	1 49.7
55 8	8 36.9	1.2	55 4	5 8.8	50 3	3 18.8	32 30	1 48.2
6 0	8 30.9	1.2	11 0	4 56.7	17 0	3 16.9	33 0	1 46.7
5 8	8 24.9	1.2	5 4	4 54.6	10 3	3 15.1	33 30	1 45.3
10 8	8 19.1	1.1	10 4	4 52.5	20 3	3 13.4	34 0	1 44.0
15 8	8 13.4	1.1	15 4	4 50.5	30 3	3 11.6	34 30	1 42.7
20 8	8 7.8	1.1	20 4	4 48.5	40 3	3 9.9	35 0	1 41.4
25 8	8 2.4	1.1	25 4	4 46.6	50 3	3 8.2	35 30	1 40.2
6 30	7 57.0	1.0	11 30	4 44.6	18 0	3 6.6	36 0	1 39.0
35 7	7 51.8	1.0	35 4	4 42.7	10 3	3 5.0	36 30	1 37.8
40 7	7 46.7	1.0	40 4	4 40.8	20 3	3 3.4	37 0	1 36.7
45 7	7 41.7	1.0	45 4	4 38.9	30 3	3 1.8	37 30	1 35.6
50 7	7 36.7	1.0	50 4	4 37.1	40 3	3 0.3	38 0	1 34.5
55 7	7 31.9	0.9	55 4	4 35.3	50 2	2 58.8	38 30	1 33.5
7 0	7 27.2	0.9	12 0	4 33.5	19 0	2 57.3	39 0	1 32.5
5 7	7 22.6	0.9	5 4	4 31.7	10 2	2 55.9	39 30	1 31.5
10 7	7 18.0	0.9	10 4	4 30.0	20 2	2 54.4	40 0	1 30.6
15 7	7 13.6	0.9	15 4	4 28.3	30 2	2 53.0	40 30	1 29.6
20 7	7 9.2	0.9	20 4	4 26.6	40 2	2 51.6	41 0	1 28.7
25 7	7 4.9	0.8	25 4	4 24.9	50 2	2 50.3	41 30	1 27.8
7 30	7 0.8	0.8	12 30	4 23.2	20 0	2 49.0	42 0	1 27.0
35 6	6 56.6	0.8	35 4	4 21.6	10 2	2 47.6	42 30	1 26.2
40 6	6 52.6	0.8	40 4	4 20.0	20 2	2 46.4	43 0	1 25.4
45 6	6 48.6	0.8	45 4	4 18.4	30 2	2 45.1	43 30	1 24.6
50 6	6 44.8	0.8	50 4	4 16.8	40 2	2 43.8	44 0	1 23.8
55 6	6 40.9	0.7	55 4	4 15.2	50 2	2 42.6	44 30	1 23.1
8 0	6 37.2	0.7	13 0	4 13.7	21 0	2 41.4	45 0	1 22.4
5 6	6 33.5	0.7	5 4	4 12.2	10 2	2 40.2	46 0	1 21.0
10 6	6 29.9	0.7	10 4	4 10.7	20 2	2 39.0	47 0	1 19.6
15 6	6 26.3	0.7	15 4	4 9.2	30 2	2 37.9	48 0	1 18.4
20 6	6 22.8	0.7	20 4	4 7.7	40 2	2 36.7	49 0	1 17.2
25 6	6 19.4	0.7	25 4	4 6.3	50 2	2 35.6	50 0	1 16.0
8 30	6 16.0	0.7	13 30	4 4.8	22 0	2 34.5	51 0	1 15.0
35 6	6 12.7	0.6	35 4	4 3.4	10 2	2 33.4	52 0	1 13.9
40 6	6 9.5	0.6	40 4	4 2.0	20 2	2 32.4	53 0	1 13.0
45 6	6 6.3	0.6	45 4	4 0.6	30 2	2 31.3	54 0	1 12.0
50 6	6 3.1	0.6	50 3	3 59.3	40 2	2 30.3	55 0	1 11.1
55 6	6 0.0	0.6	55 3	3 57.9	50 2	2 29.2	56 0	1 10.3
9 0	5 57.0	0.6	14 0	3 56.6	23 0	2 28.2	57 0	1 9.5
5 5	5 54.0	0.6	5 3	3 55.3	20 2	2 26.3	58 0	1 8.7
10 5	5 51.1	0.6	10 3	3 54.0	40 2	2 24.4	59 0	1 8.0
15 5	5 48.2	0.6	15 3	3 52.7	24 0	2 22.5	60 0	1 7.3
20 5	5 45.3	0.6	20 3	3 51.4	20 2	2 20.7	62 0	1 6.0
25 5	5 42.5	0.5	25 3	3 50.1	40 2	2 18.9	64 0	1 4.9
9 30	5 39.8	0.5	14 30	3 48.9	25 0	2 17.2	66 0	1 3.8
35 5	5 37.0	0.5	35 3	3 47.6	20 2	2 15.5	68 0	1 2.9
40 5	5 34.4	0.5	40 3	3 46.4	40 2	2 13.9	70 0	1 2.0
45 5	5 31.7	0.5	45 3	3 45.2	26 0	2 12.3	73 0	1 1.0
50 5	5 29.2	0.5	50 3	3 44.0	20 2	2 10.8	76 0	1 0.1
55 5	5 26.6	0.5	55 3	3 42.8	40 2	2 9.3	80 0	0 59.2
10 0	5 24.1		15 0	3 41.7	27 0	2 7.8	90 0	0 58.3

TABLE IV. A.

Correction of the Mean Refraction for the Height of the Barometer.

Barometer.		MEAN REFRACTION.																				Barometer.	
Subtract.	0'		1'		2'		3'		4'		5'		6'		7'		8'		9'		10'		Add.
	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	
27.50	0	2	5	7	10	12	15	17	20	23	25	28	30	33	35	38	40	43	45	48	51		
27.55	0	2	5	7	10	12	15	17	20	22	25	27	30	32	35	37	40	42	45	47	50		
27.60	0	2	5	7	10	12	14	17	19	22	24	27	29	31	34	36	39	41	44	46	49		
27.65	0	2	5	7	9	12	14	16	19	21	24	26	28	31	33	36	38	40	43	45	48		
27.70	0	2	5	7	9	11	14	16	18	21	23	25	28	30	32	35	37	39	42	44	47		
27.75	0	2	4	7	9	11	13	16	18	20	23	25	27	29	32	34	36	39	41	43	46		
27.80	0	2	4	7	9	11	13	15	18	20	22	24	27	29	31	33	35	38	40	42	45		
27.85	0	2	4	6	9	11	13	15	17	19	22	24	26	28	30	32	35	37	39	41	44		
27.90	0	2	4	6	8	10	13	15	17	19	21	23	25	27	30	32	34	36	38	40	43		
27.95	0	2	4	6	8	10	12	14	16	18	21	23	25	27	29	31	33	35	37	39	42		
28.00	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	41		
28.05	0	2	4	6	8	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37	39		
28.10	0	2	4	6	8	9	11	13	15	17	19	21	23	25	27	29	31	33	34	36	38		
28.15	0	2	4	6	7	9	11	13	15	17	19	20	22	24	26	28	30	32	34	36	37		
28.20	0	2	4	5	7	9	11	13	14	16	18	20	22	24	25	27	29	31	33	35	36		
28.25	0	2	3	5	7	9	10	12	14	16	18	19	21	23	25	26	28	30	32	34	35		
28.30	0	2	3	5	7	8	10	12	14	15	17	19	21	22	24	26	27	29	31	33	34		
28.35	0	2	3	5	7	8	10	12	13	15	17	18	20	22	23	25	27	28	30	32	33		
28.40	0	2	3	5	6	8	10	11	13	14	16	18	19	21	23	24	26	27	29	31	32		
28.45	0	2	3	5	6	8	9	11	12	14	16	17	19	20	22	23	25	27	28	30	31		
28.50	0	1	3	4	6	7	9	10	12	14	15	17	18	20	21	23	24	26	27	29	30	31.50	
28.55	0	1	3	4	6	7	9	10	12	13	15	16	17	19	20	22	23	25	26	28	29	31.45	
28.60	0	1	3	4	6	7	8	10	11	13	14	15	17	18	20	21	23	24	25	27	28	31.40	
28.65	0	1	3	4	5	7	8	9	11	12	14	15	16	18	19	20	22	23	25	26	27	31.35	
28.70	0	1	3	4	5	6	8	9	10	12	13	14	16	17	18	20	21	22	24	25	26	31.30	
28.75	0	1	2	4	5	6	7	9	10	11	13	14	15	16	18	19	20	21	23	24	25	31.25	
28.80	0	1	2	4	5	6	7	8	10	11	12	13	14	16	17	18	19	21	22	23	24	31.20	
28.85	0	1	2	3	5	6	7	8	9	10	12	13	14	15	16	17	19	20	21	22	23	31.15	
28.90	0	1	2	3	4	5	7	8	9	10	11	12	13	14	16	17	18	19	20	21	22	31.10	
28.95	0	1	2	3	4	5	6	7	8	9	11	12	13	14	15	16	17	18	19	20	21	31.05	
29.00	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	31.00	
29.05	0	1	2	3	4	5	6	7	8	9	10	11	11	12	13	14	15	16	17	18	19	30.95	
29.10	0	1	2	3	4	4	5	6	7	8	9	10	11	12	13	14	15	15	16	17	18	30.90	
29.15	0	1	2	3	3	4	5	6	7	8	9	9	10	11	12	13	14	15	15	16	17	30.85	
29.20	0	1	2	2	3	4	5	6	6	7	8	9	10	10	11	12	13	14	15	15	16	30.80	
29.25	0	1	1	2	3	4	4	5	6	7	8	8	9	10	11	11	12	13	14	14	15	30.75	
29.30	0	1	1	2	3	3	4	5	6	6	7	8	8	9	10	11	11	12	13	13	14	30.70	
29.35	0	1	1	2	3	3	4	5	5	6	7	7	8	9	10	10	11	11	12	13	13	30.65	
29.40	0	1	1	2	2	3	4	4	5	5	6	7	7	8	9	10	10	10	11	12	12	30.60	
29.45	0	1	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	9	10	11	11	30.55	
29.50	0	0	1	1	2	2	3	3	4	5	5	6	6	7	7	8	8	9	9	10	10	30.50	
29.55	0	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	9	30.45	
29.60	0	0	1	1	2	2	2	3	3	4	4	4	5	5	6	6	6	7	7	8	8	30.40	
29.65	0	0	1	1	1	2	2	2	3	3	4	4	4	5	5	5	6	6	6	7	7	30.35	
29.70	0	0	1	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	5	6	6	30.30	
29.75	0	0	0	1	1	1	1	2	2	2	3	3	3	3	4	4	4	4	5	5	5	30.25	
29.80	0	0	0	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	4	4	4	30.20	
29.85	0	0	0	0	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3	30.15	
29.90	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	30.10	
29.95	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	30.05	
30.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30.00	
Subtract.	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	Add.
Barometer.	0'		1'		2'		3'		4'		5'		6'		7'		8'		9'		10'		Barometer.
MEAN REFRACTION.																							

TABLE IV. B.

Correction of the Mean Refraction for the Height of the Thermometer.

Thermom.	MEAN REFRACTION.																					Thermom.
	0'		1'		2'		3'		4'		5'		6'		7'		8'		9'		10	
	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	
—10	0	4	8	12	16	20	24	28	33	37	41	46	50	55	60	65	70	75	80	85	90	—10
— 8	0	4	8	12	15	19	23	27	31	36	40	44	48	53	58	62	67	72	77	82	87	— 8
— 6	0	4	7	11	15	19	22	26	30	34	38	42	47	51	55	60	64	69	74	79	84	— 6
— 4	0	4	7	11	14	18	22	25	29	33	37	41	45	49	53	57	62	66	71	76	80	— 4
— 2	0	3	7	10	14	17	21	24	28	31	35	39	43	47	51	55	59	64	68	72	77	— 2
0	0	3	7	10	13	16	20	23	27	30	34	37	41	45	49	53	57	61	65	69	74	0
2	0	3	6	9	12	16	19	22	25	29	32	36	39	43	47	50	54	58	62	66	70	2
4	0	3	6	9	12	15	18	21	24	28	31	34	37	41	44	48	52	55	59	63	67	4
6	0	3	6	8	11	14	17	20	23	26	29	32	36	39	42	46	49	53	56	60	64	6
8	0	3	5	8	11	14	16	19	22	25	28	31	34	37	40	43	47	50	54	57	61	8
10	0	3	5	8	10	13	15	18	21	24	26	29	32	35	38	41	44	48	51	54	58	10
11	0	2	5	7	10	13	15	18	20	23	26	28	31	34	37	40	43	46	49	53	56	11
12	0	2	5	7	10	12	15	17	20	22	25	28	30	33	36	39	42	45	48	51	54	12
13	0	2	5	7	9	12	14	17	19	22	24	27	30	32	35	38	41	44	47	50	53	13
14	0	2	5	7	9	11	14	16	19	21	24	26	29	31	34	37	40	42	45	48	51	14
15	0	2	4	7	9	11	13	16	18	20	23	25	28	30	33	36	38	41	44	47	50	15
16	0	2	4	6	9	11	13	15	18	20	22	25	27	29	32	35	37	40	43	45	48	16
17	0	2	4	6	8	10	13	15	17	19	21	24	26	29	31	33	36	39	41	44	47	17
18	0	2	4	6	8	10	12	14	16	19	21	23	25	28	30	32	35	37	40	43	45	18
19	0	2	4	6	8	10	12	14	16	18	20	22	24	27	29	31	34	36	39	41	44	19
20	0	2	4	6	8	9	11	13	15	17	19	22	24	26	28	30	33	35	37	40	42	20
21	0	2	4	5	7	9	11	13	15	17	19	21	23	25	27	29	31	34	36	38	41	21
22	0	2	3	5	7	9	11	12	14	16	18	20	22	24	26	28	30	32	35	37	39	22
23	0	2	3	5	7	8	10	12	14	15	17	19	21	23	25	27	29	31	33	36	38	23
24	0	2	3	5	6	8	10	11	13	15	17	18	20	22	24	26	28	30	32	34	36	24
25	0	2	3	5	6	8	9	11	13	14	16	18	19	21	23	25	27	29	31	33	35	25
26	0	1	3	4	6	7	9	11	12	14	15	17	19	20	22	24	26	28	29	31	33	26
27	0	1	3	4	6	7	9	10	12	13	15	16	18	19	21	23	25	26	38	30	32	27
28	0	1	3	4	5	7	8	10	11	12	14	15	17	19	20	22	23	25	27	29	30	28
29	0	1	3	4	5	6	8	9	11	12	13	15	16	18	19	21	22	24	26	27	29	29
30	0	1	2	4	5	6	7	9	10	11	13	14	15	17	18	20	21	23	24	26	28	30
31	0	1	2	3	5	6	7	8	9	11	12	13	15	16	17	19	20	22	23	25	26	31
32	0	1	2	3	4	6	7	8	9	10	11	13	14	15	16	18	19	20	22	23	25	32
33	0	1	2	3	4	5	6	7	8	10	11	12	13	14	15	17	18	19	21	22	23	33
34	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	17	18	19	21	22	34
35	0	1	2	3	4	5	6	6	7	8	9	10	11	13	14	15	16	17	18	19	20	35
36	0	1	2	3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	36
37	0	1	2	2	3	4	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	37
38	0	1	1	2	3	4	4	5	6	7	7	8	9	10	11	12	13	13	14	15	16	38
39	0	1	1	2	3	3	4	5	5	6	7	8	8	9	10	11	11	12	13	14	15	39
40	0	1	1	2	2	3	4	4	5	6	6	7	8	8	9	10	10	11	12	13	13	40
41	0	1	1	2	2	3	3	4	4	5	6	6	7	7	8	9	9	10	11	11	12	41
42	0	0	1	1	2	2	3	3	4	4	5	5	6	7	7	8	8	9	9	10	11	42
43	0	0	1	1	2	2	3	3	3	4	4	5	5	6	6	7	7	8	8	9	9	43
44	0	0	1	1	1	2	2	3	3	3	4	4	4	5	5	6	6	7	7	8	8	44
45	0	0	1	1	1	1	2	2	2	3	3	3	4	4	4	5	5	6	6	6	7	45
46	0	0	0	1	1	1	1	2	2	2	2	3	3	3	4	4	4	4	5	5	5	46
47	0	0	0	1	1	1	1	1	2	2	2	2	2	3	3	3	3	4	4	4	4	47
48	0	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	48
49	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	49
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50
Add.	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	Add.
Thermom.	0'	1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	Thermom.										
MEAN REFRACTION.																						

TABLE IV. B.

Correction of the Mean Refraction for the Height of the Thermometer.

Thermom.	MEAN REFRACTION.																					Thermom.	
	0'		1'		2'		3'		4'		5'		6'		7'		8'		9'		10'		Subtract.
	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0		
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	
51	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	51	
52	0	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	52	
53	0	0	0	0	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	4	4	53	
54	0	0	0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	5	5	5	54	
55	0	0	1	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	55	
56	0	0	1	1	1	2	2	2	3	3	4	4	4	5	5	6	6	6	7	7	8	56	
57	0	0	1	1	2	2	2	3	3	4	4	5	5	6	6	6	7	8	8	9	9	57	
58	0	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	9	9	10	10	58	
59	0	1	1	2	2	3	3	4	4	5	5	6	6	7	8	8	9	10	10	11	12	59	
60	0	1	1	2	2	3	3	4	5	5	6	7	7	8	9	9	10	11	11	12	13	60	
61	0	1	1	2	3	3	4	4	5	6	7	7	8	9	9	10	11	12	12	13	14	61	
62	0	1	1	2	3	3	4	5	6	6	7	8	9	9	10	11	12	13	14	15	15	62	
63	0	1	1	2	3	4	5	5	6	7	8	8	9	10	11	12	13	14	15	16	17	63	
64	0	1	2	2	3	4	5	6	7	7	8	9	10	11	12	13	14	15	16	17	18	64	
65	0	1	2	3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	65	
66	0	1	2	3	4	5	6	6	7	8	9	10	11	12	14	15	16	17	18	19	20	66	
67	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	17	18	19	20	22	67	
68	0	1	2	3	4	5	6	7	8	9	11	11	13	14	15	16	18	19	20	22	23	68	
69	0	1	2	3	4	5	7	8	9	10	11	12	13	15	16	17	19	20	21	23	24	69	
70	0	1	2	3	5	6	7	8	9	10	12	12	14	16	17	18	20	21	22	24	25	70	
71	0	1	2	4	5	6	7	8	10	11	12	13	15	16	18	19	20	22	23	25	27	71	
72	0	1	2	4	5	6	8	9	10	11	13	14	16	17	18	20	21	23	25	26	28	72	
73	0	1	3	4	5	7	8	9	11	12	13	14	16	18	19	21	22	24	26	27	29	73	
74	0	1	3	4	5	7	8	10	11	12	14	15	17	18	20	22	23	25	27	28	30	74	
75	0	1	3	4	6	7	8	10	11	13	14	16	18	19	21	22	24	26	28	29	31	75	
76	0	1	3	4	6	7	9	10	12	13	15	16	18	20	22	23	25	27	29	31	32	76	
77	0	1	3	5	6	8	9	11	12	14	16	17	19	21	22	24	26	28	30	32	34	77	
78	0	2	3	5	6	8	9	11	13	14	16	18	20	21	23	25	27	29	31	33	35	78	
79	0	2	3	5	6	8	10	11	13	15	17	18	20	22	24	26	28	30	32	34	36	79	
80	0	2	3	5	7	8	10	12	14	15	17	19	21	23	25	27	29	31	33	35	37	80	
81	0	2	3	5	7	9	10	12	14	16	18	20	21	24	26	28	30	32	34	36	38	81	
82	0	2	4	5	7	9	11	13	14	16	18	20	22	24	26	28	31	33	35	37	40	82	
83	0	2	4	5	7	9	11	13	15	17	19	21	23	25	27	29	31	34	36	38	41	83	
84	0	2	4	6	8	9	11	13	15	17	19	21	23	26	28	30	32	35	37	39	42	84	
85	0	2	4	6	8	10	12	14	16	18	20	22	24	26	29	31	33	36	38	40	43	85	
86	0	2	4	6	8	10	12	14	16	18	20	23	25	27	29	32	34	37	39	42	44	86	
87	0	2	4	6	8	10	12	14	17	19	21	23	25	28	30	32	35	38	40	43	45	87	
88	0	2	4	6	8	10	13	15	17	19	21	24	26	28	31	33	36	38	41	44	46	88	
89	0	2	4	6	9	11	13	15	17	20	22	24	27	29	32	34	37	39	42	45	48	89	
90	0	2	4	7	9	11	13	16	18	20	23	25	27	30	32	35	38	40	43	46	49	90	
91	0	2	4	7	9	11	14	16	18	21	23	25	28	31	33	36	39	41	44	47	50	91	
92	0	2	5	7	9	11	14	16	19	21	24	26	29	31	34	37	39	42	45	48	51	92	
93	0	2	5	7	9	12	14	17	19	22	24	27	29	32	35	37	40	43	46	49	52	93	
94	0	2	5	7	10	12	14	17	19	22	25	27	30	33	35	38	41	44	47	50	53	94	
95	0	2	5	7	10	12	15	17	20	22	25	28	30	33	36	39	42	45	48	51	54	95	
96	0	2	5	7	10	12	15	18	20	23	26	28	31	34	37	40	43	46	49	52	55	96	
97	0	3	5	8	10	13	15	18	21	23	26	29	32	35	38	41	44	47	50	53	56	97	
98	0	3	5	8	10	13	16	18	21	24	27	29	32	35	38	41	44	48	51	54	58	98	
99	0	3	5	8	11	13	16	19	21	24	27	30	33	36	39	42	45	49	52	55	59	99	
100	0	3	5	8	11	13	16	19	22	25	28	31	34	37	40	43	46	50	53	56	60	100	
Subtract.	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	Subtract.	
Thermom.	0	1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	MEAN REFRACTION.										Thermom.	

TABLE V. LOG. A.

Logs A, B, C, and D, for Computing the *First Correction* of the Lunar Distance.

App. Alt. of D		REDUCED PARALLAX AND REFRACTION OF D.															
		11'	12'	13'	14'	15'	16'	17'	18'	19'	20'	21'	22'	23'	24'	25'	
5° 0'	0.288	0.295	0.301	0.308	0.315	0.321	0.328	0.335	0.341	0.348	0.355	0.361	0.366				
2	0.286	0.293	0.299	0.306	0.313	0.319	0.326	0.333	0.339	0.346	0.352	0.359	0.366				
4	0.284	0.291	0.297	0.304	0.311	0.317	0.324	0.330	0.337	0.344	0.350	0.357	0.363				
6	0.282	0.289	0.296	0.302	0.309	0.315	0.322	0.328	0.335	0.341	0.348	0.354	0.361				
8	0.281	0.287	0.294	0.300	0.307	0.313	0.320	0.326	0.333	0.339	0.346	0.352	0.359				
5 10	0.279	0.285	0.292	0.298	0.305	0.311	0.318	0.324	0.331	0.337	0.344	0.350	0.356				
12	0.277	0.284	0.290	0.296	0.303	0.309	0.316	0.322	0.329	0.335	0.341	0.348	0.354				
14	0.275	0.282	0.288	0.295	0.301	0.307	0.314	0.320	0.327	0.333	0.339	0.346	0.352				
16	0.274	0.280	0.286	0.293	0.299	0.306	0.312	0.318	0.325	0.331	0.337	0.344	0.350				
18	0.272	0.278	0.285	0.291	0.297	0.304	0.310	0.316	0.323	0.329	0.335	0.341	0.348				
5 20	0.270	0.277	0.283	0.289	0.296	0.302	0.308	0.314	0.321	0.327	0.333	0.339	0.346				
22	0.269	0.275	0.281	0.288	0.294	0.300	0.306	0.313	0.319	0.325	0.331	0.337	0.344				
24	0.267	0.273	0.280	0.286	0.292	0.298	0.304	0.311	0.317	0.323	0.329	0.335	0.341				
26	0.265	0.272	0.278	0.284	0.290	0.296	0.303	0.309	0.315	0.321	0.327	0.333	0.339	0.346			
28	0.264	0.270	0.276	0.282	0.289	0.295	0.301	0.307	0.313	0.319	0.325	0.331	0.337	0.344			
5 30	0.262	0.268	0.275	0.281	0.287	0.293	0.299	0.305	0.311	0.317	0.323	0.329	0.335	0.342			
32	0.261	0.267	0.273	0.279	0.285	0.291	0.297	0.303	0.309	0.315	0.321	0.327	0.334	0.340			
34	0.259	0.265	0.271	0.277	0.283	0.290	0.296	0.302	0.308	0.314	0.320	0.326	0.332	0.338			
36	0.258	0.264	0.270	0.276	0.282	0.288	0.294	0.300	0.306	0.312	0.318	0.324	0.330	0.336			
38		0.262	0.268	0.274	0.280	0.286	0.292	0.298	0.304	0.310	0.316	0.322	0.328	0.334			
5 40		0.261	0.267	0.273	0.279	0.285	0.290	0.296	0.302	0.308	0.314	0.320	0.326	0.332			
42		0.259	0.265	0.271	0.277	0.283	0.289	0.295	0.301	0.306	0.312	0.318	0.324	0.330			
44		0.258	0.264	0.270	0.275	0.281	0.287	0.293	0.299	0.305	0.311	0.316	0.322	0.328			
46		0.256	0.262	0.268	0.274	0.280	0.286	0.291	0.297	0.303	0.309	0.315	0.320	0.326			
48		0.255	0.261	0.267	0.272	0.278	0.284	0.290	0.296	0.301	0.307	0.313	0.319	0.324			
5 50		0.253	0.259	0.265	0.271	0.277	0.282	0.288	0.294	0.300	0.305	0.311	0.317	0.323			
52		0.252	0.258	0.264	0.269	0.275	0.281	0.287	0.292	0.298	0.304	0.309	0.315	0.321			
54		0.251	0.256	0.262	0.268	0.274	0.279	0.285	0.291	0.296	0.302	0.308	0.313	0.319			
56		0.249	0.255	0.261	0.266	0.272	0.278	0.283	0.289	0.295	0.300	0.306	0.312	0.317			
58		0.248	0.254	0.259	0.265	0.271	0.276	0.282	0.287	0.293	0.299	0.304	0.310	0.316			
6 0		0.247	0.252	0.258	0.263	0.269	0.275	0.280	0.286	0.291	0.297	0.303	0.308	0.314			
2		0.245	0.251	0.256	0.262	0.268	0.273	0.279	0.284	0.290	0.295	0.301	0.307	0.312			
4		0.244	0.249	0.255	0.261	0.266	0.272	0.277	0.283	0.288	0.294	0.299	0.305	0.310			
6		0.243	0.248	0.254	0.259	0.265	0.270	0.276	0.281	0.287	0.292	0.298	0.303	0.309			
8		0.241	0.247	0.252	0.258	0.263	0.269	0.274	0.280	0.285	0.291	0.296	0.302	0.307			
6 10		0.240	0.246	0.251	0.256	0.262	0.267	0.273	0.278	0.284	0.289	0.295	0.300	0.306			
12		0.239	0.244	0.250	0.255	0.261	0.266	0.271	0.277	0.282	0.288	0.293	0.299	0.304			
14		0.237	0.243	0.248	0.254	0.259	0.265	0.270	0.275	0.281	0.286	0.292	0.297	0.302			
16		0.236	0.242	0.247	0.252	0.258	0.263	0.269	0.274	0.279	0.285	0.290	0.295	0.301			
18		0.235	0.240	0.246	0.251	0.257	0.262	0.267	0.273	0.278	0.283	0.289	0.294	0.299			
6 20		0.234	0.239	0.245	0.250	0.255	0.261	0.266	0.271	0.276	0.282	0.287	0.292	0.298			
22		0.233	0.238	0.243	0.249	0.254	0.259	0.264	0.270	0.275	0.280	0.286	0.291	0.296			
24		0.231	0.237	0.242	0.247	0.253	0.258	0.263	0.268	0.274	0.279	0.284	0.289	0.295			
26			0.236	0.241	0.246	0.251	0.257	0.262	0.267	0.272	0.277	0.283	0.288	0.293			
28			0.234	0.240	0.245	0.250	0.255	0.260	0.266	0.271	0.276	0.281	0.286	0.292	0.297		
6 30			0.233	0.239	0.244	0.249	0.254	0.259	0.264	0.270	0.275	0.280	0.285	0.290	0.295		
32			0.232	0.237	0.242	0.248	0.253	0.258	0.263	0.268	0.273	0.278	0.284	0.289	0.294		
34			0.231	0.236	0.241	0.246	0.251	0.257	0.262	0.267	0.272	0.277	0.282	0.287	0.292		
36			0.230	0.235	0.240	0.245	0.250	0.255	0.260	0.266	0.271	0.276	0.281	0.286	0.291		
38			0.229	0.234	0.239	0.244	0.249	0.254	0.259	0.264	0.269	0.274	0.279	0.284	0.290		
6 40			0.227	0.232	0.238	0.243	0.248	0.253	0.258	0.263	0.268	0.273	0.278	0.283	0.288		
42			0.226	0.231	0.236	0.241	0.246	0.252	0.257	0.262	0.267	0.272	0.277	0.282	0.287		
44			0.225	0.230	0.235	0.240	0.245	0.250	0.255	0.260	0.265	0.270	0.275	0.280	0.285		
46			0.224	0.229	0.234	0.239	0.244	0.249	0.254	0.259	0.264	0.269	0.274	0.279	0.284		
48			0.223	0.228	0.233	0.238	0.243	0.248	0.253	0.258	0.263	0.268	0.273	0.278	0.283		
6 50			0.222	0.227	0.232	0.237	0.242	0.247	0.252	0.257	0.262	0.266	0.271	0.276	0.281		
52			0.221	0.226	0.231	0.236	0.241	0.246	0.250	0.255	0.260	0.265	0.270	0.275	0.280		
54			0.220	0.225	0.230	0.235	0.239	0.244	0.249	0.254	0.259	0.264	0.269	0.274	0.279		
56			0.219	0.224	0.229	0.233	0.238	0.243	0.248	0.253	0.258	0.263	0.267	0.272	0.277		
58			0.218	0.223	0.227	0.232	0.237	0.242	0.247	0.252	0.257	0.261	0.266	0.271	0.276		
7 0			0.217	0.222	0.226	0.231	0.236	0.241	0.246	0.251	0.255	0.260	0.265	0.270	0.275		

TABLE V. LOG. A.

Logs. A, B, C, and D, for Lunars.

App. Alt.		REDUCED PARALLAX AND REFRACTION OF C.														
of D.		44'	45'	46'	47'	48'	49'	50'	51'	52'	53'	54'	55'	56'	57'	
7° 0'	.0222	0226	0231	0236	0241	0246	0251	0255	0260	0265	0270	0275				
3	.0220	0225	0230	0234	0239	0244	0249	0254	0258	0263	0268	0273				
6	.0218	0223	0228	0233	0238	0242	0247	0252	0257	0261	0266	0271				
9	.0217	0222	0226	0231	0236	0241	0245	0250	0255	0260	0264	0269				
12	.0215	0220	0225	0230	0234	0239	0244	0248	0253	0258	0262	0267				
7 15	.0214	0219	0223	0228	0233	0237	0242	0247	0251	0256	0261	0265				
18	.0213	0217	0222	0226	0231	0236	0240	0245	0250	0254	0259	0263				
21	.0211	0216	0220	0225	0230	0234	0239	0243	0248	0253	0257	0262				
24	.0210	0214	0219	0223	0228	0233	0237	0242	0246	0251	0255	0260				
27	.0208	0213	0217	0222	0227	0231	0236	0240	0245	0249	0254	0258				
7 30	.0207	0211	0216	0220	0225	0230	0234	0239	0243	0248	0252	0257				
33	.0206	0210	0215	0219	0224	0228	0232	0237	0241	0246	0250	0255				
36	.0204	0209	0213	0218	0222	0227	0231	0235	0240	0244	0249	0253				
39	.0203	0207	0212	0216	0221	0225	0229	0234	0238	0243	0247	0252				
42	.0202	0206	0210	0215	0219	0224	0228	0232	0237	0241	0246	0250				
7 45	.0200	0205	0209	0213	0218	0222	0227	0231	0235	0240	0244	0248				
48	.0199	0203	0208	0212	0216	0221	0225	0229	0234	0238	0242	0247				
51	.0198	0202	0206	0211	0215	0219	0224	0228	0232	0237	0241	0245	0249			
54	.0196	0201	0205	0209	0214	0218	0222	0227	0231	0235	0239	0244	0248			
57	.0195	0200	0204	0208	0212	0217	0221	0225	0229	0234	0238	0242	0246			
8 0	.0194	0198	0203	0207	0211	0215	0219	0224	0228	0232	0236	0241	0245			
3	.0193	0197	0201	0206	0210	0214	0218	0222	0227	0231	0235	0239	0243			
6	.0192	0196	0200	0204	0208	0213	0217	0221	0225	0229	0233	0238	0242			
9		0195	0199	0203	0207	0211	0215	0220	0224	0228	0232	0236	0240			
12		0193	0198	0202	0206	0210	0214	0218	0222	0227	0231	0235	0239			
8 15		0192	0196	0201	0205	0209	0213	0217	0221	0225	0229	0233	0237			
18		0191	0195	0199	0203	0207	0212	0217	0220	0224	0228	0232	0236			
21		0190	0194	0198	0202	0206	0210	0214	0218	0222	0226	0231	0235			
24		0189	0193	0197	0201	0205	0209	0213	0217	0221	0225	0229	0233			
27		0188	0192	0196	0200	0204	0208	0212	0216	0220	0224	0228	0232			
8 30		0187	0191	0195	0199	0203	0207	0211	0215	0219	0223	0226	0230			
33		0186	0190	0193	0197	0201	0205	0209	0213	0217	0221	0225	0229			
36		0184	0188	0192	0196	0200	0204	0208	0212	0216	0220	0224	0228			
39		0183	0187	0191	0195	0199	0203	0207	0211	0215	0219	0223	0226			
42		0182	0186	0190	0194	0198	0202	0206	0210	0214	0217	0221	0225			
8 45		0181	0185	0189	0193	0197	0201	0205	0208	0212	0216	0220	0224			
48		0180	0184	0188	0192	0196	0200	0203	0207	0211	0215	0219	0223			
51		0179	0183	0187	0191	0195	0198	0202	0206	0210	0214	0218	0221			
54		0178	0182	0186	0190	0193	0197	0201	0205	0209	0212	0216	0220			
57		0177	0181	0185	0189	0192	0196	0200	0204	0208	0211	0215	0219			
9 0		0176	0180	0184	0188	0191	0195	0199	0203	0206	0210	0214	0218			
3		0175	0179	0183	0186	0190	0194	0198	0201	0205	0209	0213	0216			
6		0174	0178	0182	0185	0189	0193	0197	0200	0204	0208	0211	0215			
9		0173	0177	0181	0184	0188	0192	0196	0199	0203	0207	0210	0214			
12		0172	0176	0180	0183	0187	0191	0194	0198	0202	0206	0209	0213			
9 15		0171	0175	0179	0182	0186	0190	0193	0197	0201	0204	0208	0212			
18		0170	0174	0178	0181	0185	0189	0192	0196	0200	0203	0207	0211			
21		0170	0173	0177	0180	0184	0188	0191	0195	0199	0202	0206	0209			
24			0172	0176	0179	0183	0187	0190	0194	0198	0201	0205	0208			
27			0171	0175	0179	0182	0186	0189	0193	0196	0200	0204	0207			
9 30			0170	0174	0178	0181	0185	0188	0192	0195	0199	0203	0206			
33			0170	0173	0177	0180	0184	0187	0191	0194	0198	0201	0205			
36			0169	0172	0176	0179	0183	0186	0190	0193	0197	0200	0204			
39			0168	0171	0175	0178	0182	0185	0189	0192	0196	0199	0203			
42			0167	0170	0174	0177	0181	0184	0188	0191	0195	0198	0202			
9 45			0166	0169	0173	0176	0180	0183	0187	0190	0194	0197	0201			
48			0165	0169	0172	0176	0179	0182	0186	0189	0193	0196	0200	0203		
51			0164	0168	0171	0175	0178	0182	0185	0188	0192	0195	0199	0202		
54			0163	0167	0170	0174	0177	0181	0184	0187	0191	0194	0198	0201		
57			0163	0166	0169	0173	0176	0180	0183	0186	0190	0193	0197	0200		
10 0			0162	0165	0169	0172	0175	0179	0182	0186	0189	0192	0196	0199		

TABLE V. LOG. A.

Logs. A, B, C, and D, for Lunars.

App. Alt. of D.	REDUCED PARALLAX AND REFRACTION OF D.																	
	46'	47'	48'	49'	50'	51'	52'	53'	54'	55'	56'	57'	58'					
10° 0'	.0162	.0165	.0169	.0172	.0175	.0179	.0182	.0186	.0189	.0192	.0196	.0199						
5	.0160	.0164	.0167	.0171	.0174	.0177	.0181	.0184	.0187	.0191	.0194	.0197						
10	.0159	.0162	.0166	.0169	.0172	.0176	.0179	.0182	.0186	.0189	.0192	.0196						
15	.0158	.0161	.0164	.0168	.0171	.0174	.0178	.0181	.0184	.0187	.0191	.0194						
20	.0156	.0160	.0163	.0166	.0170	.0173	.0176	.0179	.0183	.0186	.0189	.0192						
25	.0155	.0158	.0162	.0165	.0168	.0171	.0175	.0178	.0181	.0184	.0188	.0191						
10 30	.0154	.0157	.0160	.0164	.0167	.0170	.0173	.0177	.0180	.0183	.0186	.0189						
35	.0153	.0156	.0159	.0162	.0166	.0169	.0172	.0175	.0178	.0181	.0185	.0188						
40	.0151	.0155	.0158	.0161	.0164	.0167	.0171	.0174	.0177	.0180	.0183	.0186						
45	.0150	.0153	.0157	.0160	.0163	.0166	.0169	.0172	.0175	.0179	.0182	.0185						
50	.0149	.0152	.0155	.0158	.0162	.0165	.0168	.0171	.0174	.0177	.0180	.0183						
55	.0148	.0151	.0154	.0157	.0160	.0163	.0167	.0170	.0173	.0176	.0179	.0182						
11 0	.0147	.0150	.0153	.0156	.0159	.0162	.0165	.0168	.0171	.0174	.0177	.0181						
5	.0146	.0149	.0152	.0155	.0158	.0161	.0164	.0167	.0170	.0173	.0176	.0179						
10		.0148	.0151	.0154	.0157	.0160	.0163	.0166	.0169	.0172	.0175	.0178						
15		.0146	.0149	.0152	.0155	.0158	.0161	.0164	.0167	.0170	.0173	.0176						
20		.0145	.0148	.0151	.0154	.0157	.0160	.0163	.0166	.0169	.0172	.0175						
25		.0144	.0147	.0150	.0153	.0156	.0159	.0162	.0165	.0168	.0171	.0174						
11 30		.0143	.0146	.0149	.0152	.0155	.0158	.0161	.0164	.0167	.0170	.0172						
35		.0142	.0145	.0148	.0151	.0154	.0157	.0160	.0162	.0165	.0168	.0171						
40		.0141	.0144	.0147	.0150	.0153	.0156	.0158	.0161	.0164	.0167	.0170						
45		.0140	.0143	.0146	.0149	.0151	.0154	.0157	.0160	.0163	.0166	.0169						
50		.0139	.0142	.0145	.0148	.0150	.0153	.0156	.0159	.0162	.0165	.0167						
55		.0138	.0141	.0144	.0146	.0149	.0152	.0155	.0158	.0161	.0163	.0166						
12 0		.0137	.0140	.0143	.0145	.0148	.0151	.0154	.0157	.0159	.0162	.0165						
5		.0136	.0139	.0142	.0144	.0147	.0150	.0153	.0156	.0158	.0161	.0164						
10		.0135	.0138	.0141	.0143	.0146	.0149	.0152	.0154	.0157	.0160	.0163						
15		.0134	.0137	.0140	.0142	.0145	.0148	.0151	.0153	.0156	.0159	.0162						
20		.0133	.0136	.0139	.0141	.0144	.0147	.0150	.0152	.0155	.0158	.0160						
25		.0132	.0135	.0138	.0140	.0143	.0146	.0148	.0151	.0154	.0157	.0159						
12 30		.0131	.0134	.0137	.0139	.0142	.0145	.0147	.0150	.0153	.0155	.0158						
35		.0130	.0133	.0136	.0138	.0141	.0144	.0146	.0149	.0152	.0154	.0157						
40		.0129	.0132	.0135	.0137	.0140	.0143	.0145	.0148	.0151	.0153	.0156						
45		.0129	.0131	.0134	.0136	.0139	.0142	.0144	.0147	.0150	.0152	.0155	.0158					
50		.0128	.0130	.0133	.0136	.0138	.0141	.0143	.0146	.0149	.0151	.0154	.0156					
55		.0127	.0129	.0132	.0135	.0137	.0140	.0142	.0145	.0148	.0150	.0153	.0155					
13 0		.0126	.0129	.0131	.0134	.0136	.0139	.0141	.0144	.0147	.0149	.0152	.0154					
5		.0125	.0128	.0130	.0133	.0135	.0138	.0141	.0143	.0146	.0148	.0151	.0153					
10		.0124	.0127	.0129	.0132	.0135	.0137	.0140	.0142	.0145	.0147	.0150	.0152					
15		.0123	.0126	.0129	.0131	.0134	.0136	.0139	.0141	.0144	.0146	.0149	.0151					
20		.0123	.0125	.0128	.0130	.0133	.0135	.0138	.0140	.0143	.0145	.0148	.0150					
25		.0122	.0124	.0127	.0129	.0132	.0134	.0137	.0139	.0142	.0144	.0147	.0149					
13 30		.0121	.0124	.0126	.0129	.0131	.0133	.0136	.0138	.0141	.0143	.0146	.0148					
35		.0120	.0123	.0125	.0128	.0130	.0133	.0135	.0138	.0140	.0142	.0145	.0147					
40		.0120	.0122	.0124	.0127	.0129	.0132	.0134	.0137	.0139	.0142	.0144	.0146					
45			.0121	.0124	.0126	.0128	.0131	.0133	.0136	.0138	.0141	.0143	.0145					
50			.0120	.0123	.0125	.0128	.0130	.0132	.0135	.0137	.0140	.0142	.0145					
55			.0120	.0122	.0124	.0127	.0129	.0132	.0134	.0136	.0139	.0141	.0144					
14 0			.0119	.0121	.0124	.0126	.0128	.0131	.0133	.0136	.0138	.0140	.0143					
5			.0118	.0121	.0123	.0125	.0128	.0130	.0132	.0135	.0137	.0139	.0142					
10			.0117	.0120	.0122	.0124	.0127	.0129	.0132	.0134	.0136	.0139	.0141					
15			.0117	.0119	.0121	.0124	.0126	.0128	.0131	.0133	.0135	.0138	.0140					
20			.0116	.0118	.0121	.0123	.0125	.0128	.0130	.0132	.0135	.0137	.0139					
25			.0115	.0118	.0120	.0122	.0124	.0127	.0129	.0131	.0134	.0136	.0138					
14 30			.0114	.0117	.0119	.0121	.0124	.0126	.0128	.0131	.0133	.0135	.0137					
35			.0114	.0116	.0118	.0121	.0123	.0125	.0128	.0130	.0132	.0134	.0137					
40			.0113	.0115	.0118	.0120	.0122	.0124	.0127	.0129	.0131	.0134	.0136					
45			.0112	.0115	.0117	.0119	.0121	.0124	.0126	.0128	.0130	.0133	.0135					
50			.0112	.0114	.0116	.0118	.0121	.0123	.0125	.0127	.0130	.0132	.0134					
55			.0111	.0113	.0116	.0118	.0120	.0122	.0124	.0127	.0129	.0131	.0133					
15 0			.0110	.0113	.0115	.0117	.0119	.0121	.0124	.0126	.0128	.0130	.0133					

TABLE V. LOG. A.

Logs. A, B, C, and D, for Lunars.

App. Alt. of $\odot$.	REDUCED PARALLAX AND REFRACTION OF $\odot$.															
	48'	49'	50'	51'	52'	53'	54'	55'	56'	57'	58'	59'				
15° 0'	.0110	.0113	.0115	.0117	.0119	.0121	.0124	.0126	.0128	.0130	.0133					
10	.0109	.0111	.0113	.0116	.0118	.0120	.0122	.0124	.0127	.0129	.0131					
20	.0108	.0110	.0112	.0114	.0116	.0119	.0121	.0123	.0125	.0127	.0129					
30	.0107	.0109	.0111	.0113	.0115	.0117	.0119	.0121	.0124	.0126	.0128					
40	.0105	.0107	.0110	.0112	.0114	.0116	.0118	.0120	.0122	.0124	.0126					
50	.0104	.0106	.0108	.0110	.0112	.0115	.0117	.0119	.0121	.0123	.0125					
16 0	.0103	.0105	.0107	.0109	.0111	.0113	.0115	.0117	.0119	.0121	.0124					
10	.0102	.0104	.0106	.0108	.0110	.0112	.0114	.0116	.0118	.0120	.0122					
20	.0101	.0103	.0105	.0107	.0109	.0111	.0113	.0115	.0117	.0119	.0121					
30	.0100	.0102	.0103	.0105	.0107	.0109	.0111	.0113	.0115	.0117	.0119					
40	.0098	.0100	.0102	.0104	.0106	.0108	.0110	.0112	.0114	.0116	.0118					
50	.0097	.0099	.0101	.0103	.0105	.0107	.0109	.0111	.0113	.0115	.0117					
17 0	.0096	.0098	.0100	.0102	.0104	.0106	.0108	.0110	.0112	.0114	.0116					
10	.0095	.0097	.0099	.0101	.0103	.0105	.0107	.0109	.0110	.0112	.0114					
20	.0094	.0096	.0098	.0100	.0102	.0104	.0106	.0107	.0109	.0111	.0113					
30		.0095	.0097	.0099	.0101	.0103	.0104	.0106	.0108	.0110	.0112					
40		.0094	.0096	.0098	.0100	.0101	.0103	.0105	.0107	.0109	.0111					
50		.0093	.0095	.0097	.0099	.0100	.0102	.0104	.0106	.0108	.0109					
18 0		.0092	.0094	.0096	.0098	.0099	.0101	.0103	.0105	.0107	.0108					
10		.0091	.0093	.0095	.0097	.0098	.0100	.0102	.0104	.0105	.0107	.0109				
20		.0090	.0092	.0094	.0096	.0097	.0099	.0101	.0103	.0104	.0106	.0108				
30		.0089	.0091	.0093	.0095	.0096	.0098	.0100	.0102	.0103	.0105	.0107				
40		.0088	.0090	.0092	.0094	.0095	.0097	.0099	.0101	.0102	.0104	.0106				
50		.0088	.0089	.0091	.0093	.0094	.0096	.0098	.0099	.0101	.0103	.0105				
19 0		.0087	.0088	.0090	.0092	.0093	.0095	.0097	.0098	.0100	.0102	.0104				
10		.0086	.0087	.0089	.0091	.0092	.0094	.0096	.0098	.0099	.0101	.0103				
20		.0085	.0087	.0088	.0090	.0092	.0093	.0095	.0097	.0098	.0100	.0102				
30		.0084	.0086	.0087	.0089	.0091	.0092	.0094	.0096	.0097	.0099	.0101				
40		.0083	.0085	.0087	.0088	.0090	.0091	.0093	.0095	.0096	.0098	.0100				
50		.0082	.0084	.0086	.0087	.0089	.0090	.0092	.0094	.0095	.0097	.0099				
20 0		.0082	.0083	.0085	.0086	.0088	.0090	.0091	.0093	.0094	.0096	.0098				
10		.0081	.0082	.0084	.0086	.0087	.0089	.0090	.0092	.0093	.0095	.0097				
20		.0080	.0082	.0083	.0085	.0086	.0088	.0089	.0091	.0093	.0094	.0096				
30		.0079	.0081	.0082	.0084	.0086	.0087	.0089	.0090	.0092	.0093	.0095				
40		.0079	.0080	.0082	.0083	.0085	.0086	.0088	.0089	.0091	.0092	.0094				
50		.0078	.0079	.0081	.0082	.0084	.0085	.0087	.0088	.0090	.0091	.0093				
21 0		.0077	.0079	.0080	.0082	.0083	.0085	.0086	.0088	.0089	.0091	.0092				
10		.0076	.0078	.0079	.0081	.0082	.0084	.0085	.0087	.0088	.0090	.0091				
20		.0076	.0077	.0079	.0080	.0082	.0083	.0085	.0086	.0087	.0089	.0090				
30		.0075	.0076	.0078	.0079	.0081	.0082	.0084	.0085	.0087	.0088	.0090				
40		.0074	.0076	.0077	.0079	.0080	.0082	.0083	.0084	.0086	.0087	.0089				
50		.0074	.0075	.0076	.0078	.0079	.0081	.0082	.0084	.0085	.0086	.0088				
22 0		.0073	.0074	.0076	.0077	.0079	.0080	.0081	.0083	.0084	.0086	.0087				
10		.0072	.0074	.0075	.0076	.0078	.0079	.0081	.0082	.0083	.0085	.0086				
20		.0072	.0073	.0074	.0076	.0077	.0079	.0080	.0081	.0083	.0084	.0086				
30		.0071	.0072	.0074	.0075	.0076	.0078	.0079	.0081	.0082	.0083	.0085				
40		.0070	.0072	.0073	.0074	.0076	.0077	.0079	.0080	.0081	.0083	.0084				
50		.0070	.0071	.0072	.0074	.0075	.0076	.0078	.0079	.0081	.0082	.0083				
23 0		.0069	.0070	.0072	.0073	.0074	.0076	.0077	.0078	.0080	.0081	.0082				
10		.0068	.0070	.0071	.0072	.0074	.0075	.0076	.0078	.0079	.0080	.0082				
20		.0068	.0069	.0070	.0072	.0073	.0074	.0076	.0077	.0078	.0080	.0081				
30		.0067	.0069	.0070	.0071	.0072	.0074	.0075	.0076	.0078	.0079	.0080				
40		.0067	.0068	.0069	.0071	.0072	.0073	.0074	.0076	.0077	.0078	.0080				
50		.0066	.0067	.0069	.0070	.0071	.0073	.0074	.0075	.0076	.0078	.0079				
24 0			.0067	.0068	.0069	.0071	.0072	.0073	.0074	.0076	.0077	.0078				
10			.0066	.0067	.0069	.0070	.0071	.0073	.0074	.0075	.0076	.0078				
20			.0066	.0067	.0068	.0069	.0071	.0072	.0073	.0074	.0076	.0077				
30			.0065	.0066	.0068	.0069	.0070	.0071	.0072	.0074	.0075	.0076				
40			.0065	.0066	.0067	.0068	.0069	.0071	.0072	.0073	.0074	.0076				
50			.0064	.0065	.0066	.0068	.0069	.0070	.0071	.0072	.0074	.0075				
25 0			.0063	.0065	.0066	.0067	.0068	.0069	.0071	.0072	.0073	.0074				

TABLE V. LOG. A.

Logs. A, B, C, and D, for Lunars.

App. Alt. of D.	REDUCED PARALLAX AND REFRACTION OF D.																				
	50'	51'	52'	53'	54'	55'	56'	57'	58'	59'	60'										
25° 0'	.0063	.0065	.0066	.0067	.0068	.0069	.0071	.0072	.0073	.0074											
20	.0062	.0064	.0065	.0066	.0067	.0068	.0069	.0071	.0072	.0073											
40	.0061	.0062	.0064	.0065	.0066	.0067	.0068	.0069	.0071	.0072											
26 0	.0060	.0061	.0063	.0064	.0065	.0066	.0067	.0068	.0069	.0071											
20	.0059	.0060	.0062	.0063	.0064	.0065	.0066	.0067	.0068	.0069											
40	.0058	.0059	.0061	.0062	.0063	.0064	.0065	.0066	.0067	.0068											
27 0	.0057	.0058	.0060	.0061	.0062	.0063	.0064	.0065	.0066	.0067											
20	.0056	.0057	.0059	.0060	.0061	.0062	.0063	.0064	.0065	.0066											
40	.0055	.0057	.0058	.0059	.0060	.0061	.0062	.0063	.0064	.0065											
28 0	.0055	.0056	.0057	.0058	.0059	.0060	.0061	.0062	.0063	.0064											
20	.0054	.0055	.0056	.0057	.0058	.0059	.0060	.0061	.0062	.0063											
40	.0053	.0054	.0055	.0056	.0057	.0058	.0059	.0060	.0061	.0062											
29 0	.0052	.0053	.0054	.0055	.0056	.0057	.0058	.0059	.0060	.0061											
20	.0051	.0052	.0053	.0054	.0055	.0056	.0057	.0058	.0059	.0060											
40	.0050	.0051	.0052	.0053	.0054	.0055	.0056	.0057	.0058	.0059											
30 0	.0050	.0051	.0051	.0052	.0053	.0054	.0055	.0056	.0057	.0058											
20	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056	.0057	.0058											
40	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056	.0057											
31 0	.0047	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056											
20	.0047	.0047	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056										
40	.0046	.0047	.0048	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056									
32 0	.0045	.0046	.0047	.0048	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056								
20	.0044	.0045	.0046	.0047	.0048	.0049	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056							
40	.0044	.0045	.0045	.0046	.0047	.0048	.0049	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056						
33 0	.0043	.0044	.0045	.0045	.0046	.0047	.0048	.0049	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056					
20	.0042	.0043	.0044	.0045	.0046	.0046	.0047	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056					
40	.0042	.0043	.0043	.0044	.0045	.0046	.0046	.0047	.0048	.0049	.0049	.0050	.0051	.0052	.0053	.0054	.0055				
34 0	.0041	.0042	.0043	.0043	.0044	.0045	.0046	.0046	.0047	.0048	.0049	.0049	.0050	.0051	.0052	.0053	.0054	.0055			
20	.0040	.0041	.0042	.0043	.0043	.0044	.0045	.0046	.0047	.0047	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055			
40	.0040	.0041	.0041	.0042	.0043	.0044	.0044	.0045	.0046	.0047	.0047	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055		
35 0	.0039	.0040	.0041	.0041	.0042	.0043	.0044	.0044	.0045	.0046	.0047										
20	.0039	.0039	.0040	.0041	.0042	.0042	.0043	.0044	.0044	.0045	.0046										
40	.0038	.0039	.0039	.0040	.0041	.0042	.0042	.0043	.0044	.0044	.0045	.0046									
36 0	.0037	.0038	.0039	.0040	.0040	.0041	.0042	.0042	.0043	.0044	.0044										
20	.0037	.0038	.0038	.0039	.0040	.0040	.0041	.0042	.0042	.0043	.0044	.0044									
40	.0036	.0037	.0038	.0038	.0039	.0040	.0040	.0041	.0042	.0042	.0043	.0043									
37 0	.0036	.0036	.0037	.0038	.0038	.0039	.0040	.0040	.0041	.0041	.0042	.0042									
20	.0035	.0036	.0037	.0037	.0038	.0039	.0039	.0040	.0040	.0041	.0041	.0042									
40	.0035	.0035	.0036	.0037	.0037	.0038	.0039	.0039	.0040	.0040	.0041	.0041									
38 0	.0034	.0035	.0035	.0036	.0037	.0037	.0038	.0039	.0039	.0040	.0040										
20	.0034	.0034	.0035	.0036	.0036	.0037	.0037	.0038	.0039	.0039	.0040										
40	.0033	.0034	.0034	.0035	.0036	.0036	.0037	.0037	.0038	.0039	.0039	.0040									
39 0		.0033	.0034	.0034	.0035	.0036	.0036	.0037	.0037	.0038	.0039										
20		.0033	.0033	.0034	.0035	.0035	.0036	.0036	.0037	.0037	.0038	.0039									
40		.0032	.0033	.0033	.0034	.0035	.0035	.0036	.0036	.0037	.0037	.0038									
40 0		.0032	.0032	.0033	.0033	.0034	.0035	.0035	.0036	.0036	.0037										
20		.0031	.0032	.0032	.0033	.0034	.0034	.0035	.0035	.0036	.0036										
40		.0031	.0031	.0032	.0032	.0033	.0034	.0034	.0035	.0035	.0036										
41 0		.0030	.0031	.0031	.0032	.0033	.0033	.0034	.0034	.0035	.0035										
20		.0030	.0030	.0031	.0031	.0032	.0033	.0033	.0034	.0034	.0035	.0035									
40		.0029	.0030	.0030	.0031	.0032	.0032	.0033	.0033	.0034	.0034	.0035									
42 0		.0029	.0029	.0030	.0031	.0031	.0032	.0032	.0033	.0033	.0034	.0034									
20		.0029	.0029	.0030	.0030	.0031	.0031	.0032	.0032	.0033	.0033	.0034									
40		.0028	.0029	.0029	.0030	.0030	.0031	.0031	.0032	.0032	.0033	.0033									
43 0		.0028	.0028	.0029	.0029	.0030	.0030	.0031	.0031	.0032	.0032	.0033									
20		.0027	.0028	.0028	.0029	.0029	.0030	.0030	.0031	.0031	.0032	.0032									
40		.0027	.0027	.0028	.0028	.0029	.0029	.0030	.0030	.0031	.0031	.0032									
44 0		.0026	.0027	.0027	.0028	.0028	.0029	.0029	.0030	.0030	.0031	.0031									
20		.0026	.0026	.0027	.0027	.0028	.0028	.0029	.0029	.0030	.0030	.0031									
40		.0026	.0026	.0026	.0027	.0027	.0028	.0028	.0029	.0029	.0030	.0030									
45 0		.0025	.0026	.0026	.0027	.0027	.0027	.0028	.0028	.0029	.0029	.0030									

TABLE V. LOG. A.

Logs. A, B, C, and D, for Lunars.

App. Alt. of Δ		REDUCED PARALLAX AND REFRACTION OF Δ .															
		51'	52'	53'	54'	55'	56'	57'	58'	59'	60'						
45° 0'		.0025	.0026	.0026	.0027	.0027	.0027	.0028	.0028	.0029	.0029						
30		.0025	.0025	.0025	.0026	.0026	.0027	.0027	.0028	.0028	.0028						
46 0		.0024	.0024	.0025	.0025	.0026	.0026	.0027	.0027	.0027	.0028						
30		.0023	.0024	.0024	.0025	.0025	.0026	.0026	.0026	.0027	.0027						
47 0		.0023	.0023	.0024	.0024	.0025	.0025	.0025	.0026	.0026	.0026						
30		.0022	.0023	.0023	.0024	.0024	.0024	.0025	.0025	.0025	.0026						
48 0		.0022	.0022	.0023	.0023	.0023	.0024	.0024	.0024	.0025	.0025						
30		.0021	.0022	.0022	.0022	.0023	.0023	.0024	.0024	.0024	.0025						
49 0		.0021	.0021	.0022	.0022	.0022	.0023	.0023	.0023	.0024	.0024						
30		.0020	.0021	.0021	.0021	.0022	.0022	.0022	.0023	.0023	.0023						
50 0		.0020	.0020	.0020	.0021	.0021	.0022	.0022	.0022	.0023	.0023						
30		.0019	.0020	.0020	.0020	.0021	.0021	.0021	.0022	.0022	.0022						
51 0		.0019	.0019	.0020	.0020	.0020	.0020	.0021	.0021	.0021	.0022						
30		.0018	.0019	.0019	.0019	.0020	.0020	.0020	.0021	.0021	.0021						
52 0		.0018	.0018	.0019	.0019	.0019	.0019	.0020	.0020	.0020	.0021						
30		.0018	.0018	.0018	.0018	.0019	.0019	.0019	.0020	.0020	.0020						
53 0		.0017	.0017	.0018	.0018	.0018	.0018	.0019	.0019	.0019	.0020						
30		.0017	.0017	.0017	.0017	.0018	.0018	.0018	.0019	.0019	.0019						
54 0		.0016	.0016	.0017	.0017	.0017	.0018	.0018	.0018	.0018	.0018						
30		.0016	.0016	.0016	.0017	.0017	.0017	.0017	.0018	.0018	.0018						
55 0		.0015	.0016	.0016	.0016	.0016	.0017	.0017	.0017	.0017	.0018						
30		.0015	.0015	.0015	.0016	.0016	.0016	.0016	.0017	.0017	.0017						
56 0		.0015	.0015	.0015	.0015	.0016	.0016	.0016	.0016	.0017	.0017						
30		.0014	.0014	.0015	.0015	.0015	.0015	.0016	.0016	.0016	.0016						
57 0		.0014	.0014	.0014	.0015	.0015	.0015	.0015	.0015	.0015	.0016						
30		.0014	.0014	.0014	.0014	.0014	.0015	.0015	.0015	.0015	.0015						
58 0		.0013	.0013	.0014	.0014	.0014	.0014	.0014	.0015	.0015	.0015						
30		.0013	.0013	.0013	.0013	.0014	.0014	.0014	.0014	.0014	.0015						
59 0		.0012	.0013	.0013	.0013	.0013	.0013	.0014	.0014	.0014	.0014						
30		.0012	.0012	.0012	.0013	.0013	.0013	.0013	.0013	.0014	.0014						
60		.0012	.0012	.0012	.0012	.0013	.0013	.0013	.0013	.0013	.0013						
61		.0011	.0011	.0011	.0012	.0012	.0012	.0012	.0012	.0012	.0012						
62		.0011	.0011	.0011	.0011	.0011	.0011	.0011	.0011	.0012	.0012						
63		.0010	.0010	.0010	.0010	.0011	.0011	.0011	.0011	.0011	.0011						
64		.0009	.0010	.0010	.0010	.0010	.0010	.0010	.0010	.0010	.0010						
65		.0009	.0009	.0009	.0009	.0009	.0009	.0010	.0010	.0010	.0010						
66		.0008	.0008	.0009	.0009	.0009	.0009	.0009	.0009	.0009	.0009						
67		.0008	.0008	.0008	.0008	.0008	.0008	.0008	.0008	.0009	.0009						
68		.0007	.0007	.0008	.0008	.0008	.0008	.0008	.0008	.0008	.0008						
69		.0007	.0007	.0007	.0007	.0007	.0007	.0007	.0008	.0008	.0008						
70		.0007	.0007	.0007	.0007	.0007	.0007	.0007	.0007	.0007	.0007						
71		.0006	.0006	.0006	.0006	.0006	.0006	.0007	.0007	.0007	.0007						
72		.0006	.0006	.0006	.0006	.0006	.0006	.0006	.0006	.0006	.0006						
73		.0005	.0005	.0006	.0006	.0006	.0006	.0006	.0006	.0006	.0006						
74		.0005	.0005	.0005	.0005	.0005	.0005	.0005	.0005	.0005	.0005						
75		.0005	.0005	.0005	.0005	.0005	.0005	.0005	.0005	.0005	.0005						
76		.0004	.0005	.0005	.0005	.0005	.0005	.0005	.0005	.0005	.0005						
77		.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004						
78		.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004						
79		.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004						
80		.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004						
81		.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003						
82		.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003						
83		.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003						
84		.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003						
85		.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003						
86		.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003						
87		.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003						
88		.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003						
89		.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003						
90		.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003						

TABLE V. LOG. B.

Logs. A, B, C, and D, for Lunars.

App. Alt. of ☉ or ✕.	REDUCED REFRACTION AND PARALLAX OF ☉ OR ✕.											
	0' 0"	0' 30"	1' 0"	1' 30"	2' 0"	2' 30"	3' 0"	3' 30"	4' 0"	4' 30"	5' 0"	5' 30"
5° 0'												
10												
20												
30												
40												
50												
6 0												
20												9.9970
40												9.9972
7 0											9.9976	9.9974
20											9.9977	9.9975
40										9.9981	9.9978	9.9976
8 0										9.9982	9.9979	9.9977
20										9.9982	9.9980	9.9978
40										9.9983	9.9981	9.9979
9 0									9.9986	9.9984	9.9982	9.9980
20									9.9986	9.9985	9.9983	9.9981
40									9.9987	9.9985	9.9983	9.9982
10 0								9.9989	9.9988	9.9986	9.9984	9.9982
11							9.9992	9.9991	9.9989	9.9987	9.9986	9.9984
12							9.9993	9.9992	9.9990	9.9989	9.9987	9.9986
13						9.9995	9.9994	9.9992	9.9991	9.9990	9.9989	9.9987
14						9.9995	9.9994	9.9993	9.9992	9.9991	9.9990	
15					9.9997	9.9996	9.9995	9.9994	9.9993	9.9992	9.9991	
16					9.9997	9.9996	9.9995	9.9994	9.9993	9.9993		
18				9.9990	9.9998	9.9997	9.9996	9.9995	9.9995			
20			0.0000	9.9999	9.9998	9.9998	9.9997	9.9996	9.9996			
25			0.0000	0.0000	9.9999	9.9999	9.9998	9.9998				
30		0.0001	0.0001	0.0000	0.0000	0.0000	9.9999					
50	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001						
90	0.0001	0.0002	0.0002	0.0002								

LOG. C.

App. Alt. of ☉ or ✕.	REDUCED REFRACTION AND PARALLAX OF ☉ OR ✕.											
	0' 0"	0' 30"	1' 0"	1' 30"	2' 0"	2' 30"	3' 0"	3' 30"	4' 0"	4' 30"	5' 0"	5' 30"
5° 0'												
20												
40												
6 0												
20												9.9969
40												9.9970
7 0											9.9974	9.9972
8										9.9980	9.9978	9.9975
9									9.9984	9.9982	9.9980	9.9978
10								9.9988	9.9986	9.9984	9.9982	9.9981
11							9.9990	9.9989	9.9987	9.9986	9.9984	9.9982
12							9.9991	9.9990	9.9988	9.9987	9.9985	9.9984
13						9.9993	9.9992	9.9991	9.9989	9.9988	9.9987	9.9985
14						9.9994	9.9993	9.9991	9.9990	9.9989	9.9988	
15					9.9995	9.9994	9.9993	9.9992	9.9991	9.9990	9.9989	
16					9.9996	9.9995	9.9994	9.9993	9.9992	9.9990		
17					9.9996	9.9995	9.9994	9.9993	9.9992	9.9991		
18				9.9997	9.9996	9.9995	9.9994	9.9994	9.9993			
20			9.9998	9.9998	9.9997	9.9996	9.9995	9.9994	9.9993			
25			9.9999	9.9998	9.9998	9.9997	9.9996	9.9996				
30		0.0000	9.9999	9.9999	9.9998	9.9998	9.9997					
40		0.0000	9.9999	9.9999	9.9999	9.9999						
50	0.0000	0.0000	0.0000	9.9999	9.9999							
90	0.0000	0.0000	0.0000	0.0000								

TABLE V. LOG. B.

Logs. A, B, C, and D, for Lunars.

App. Alt. of ☉ or ✕.	REDUCED REFRACTION AND PARALLAX OF ☉ OR ✕.											
	6' 0"	6' 30"	7' 0"	7' 30"	8' 0"	8' 30"	9' 0"	9' 30"	10' 0"	10' 30"	11' 0"	11' 30"
5° 0'			9.9951	9.9947	9.9944	9.9940	9.9937	9.9933	9.9929	9.9926	9.9922	9.9919
10			9.9953	9.9949	9.9946	9.9942	9.9939	9.9935	9.9932	9.9928	9.9925	9.9921
20			9.9954	9.9951	9.9948	9.9944	9.9941	9.9937	9.9934	9.9931	9.9927	9.9924
30		9.9959	9.9956	9.9952	9.9949	9.9946	9.9943	9.9939	9.9936	9.9933	9.9929	
40		9.9960	9.9957	9.9954	9.9951	9.9948	9.9944	9.9941	9.9938	9.9935	9.9932	
50	9.9965	9.9962	9.9958	9.9955	9.9952	9.9949	9.9946	9.9943	9.9940	9.9937		
6 0	9.9966	9.9963	9.9960	9.9957	9.9954	9.9951	9.9948	9.9945	9.9942	9.9939		
20	9.9968	9.9965	9.9962	9.9959	9.9956	9.9954	9.9951	9.9948	9.9945			
40	9.9969	9.9967	9.9964	9.9961	9.9959	9.9956	9.9953	9.9951	9.9948			
7 0	9.9971	9.9968	9.9966	9.9963	9.9961	9.9958	9.9956	9.9953				
20	9.9972	9.9970	9.9968	9.9965	9.9963	9.9960	9.9958					
40	9.9974	9.9971	9.9969	9.9967	9.9965	9.9962						
8 0	9.9975	9.9973	9.9971	9.9968	9.9966	9.9964						
20	9.9976	9.9974	9.9972	9.9970	9.9968							
40	9.9977	9.9975	9.9973	9.9971								
9 0	9.9978	9.9976	9.9974	9.9972								
20	9.9979	9.9977	9.9975									
40	9.9980	9.9978	9.9976									
10		9.9981	9.9979	9.9977								
11		9.9983	9.9981									
12		9.9985										
13												
14												
15												
16												
18												
20												
25												
30												
50												
90												

LOG. C.

App. Alt. of ☉ or ✕.	REDUCED REFRACTION AND PARALLAX OF ☉ OR ✕.											
	6' 0"	6' 30"	7' 0"	7' 30"	8' 0"	8' 30"	9' 0"	9' 30"	10' 0"	10' 30"	11' 0"	11' 30"
5° 0'			9.9949	9.9946	9.9942	9.9938	9.9935	9.9931	9.9927	9.9924	9.9920	9.9916
20		9.9956	9.9953	9.9949	9.9946	9.9942	9.9939	9.9936	9.9932	9.9929	9.9925	9.9922
40	9.9962	9.9959	9.9955	9.9952	9.9949	9.9946	9.9943	9.9939	9.9936	9.9933	9.9930	
6 0	9.9964	9.9961	9.9958	9.9955	9.9952	9.9949	9.9946	9.9943	9.9940	9.9937		
20	9.9966	9.9963	9.9960	9.9957	9.9955	9.9952	9.9949	9.9946	9.9943			
40	9.9968	9.9965	9.9962	9.9960	9.9957	9.9954	9.9951	9.9949	9.9946			
7	9.9969	9.9967	9.9964	9.9962	9.9959	9.9956	9.9954	9.9951				
8	9.9973	9.9971	9.9969	9.9966	9.9964	9.9962	9.9960					
9	9.9976	9.9974	9.9972	9.9970	9.9968							
10	9.9979	9.9977	9.9975									
11	9.9981	9.9979										
12	9.9983											
13												
14												
15												
16												
17												
18												
20												
25												
30												
40												
50												
90												

TABLE V. LOG. D.

Logs. A, B, C, and D, for Lunars.

App. Alt. of D.	REDUCED PARALLAX AND REFRACTION OF D.														
	41'	42'	43'	44'	45'	46'	47'	48'	49'	50'	51'	52'	53'	54'	55'
5° 0'	.0283	0290	0296	0303	0310	0316	0323	0329	0336	0343	0349	0356	0362	0369	
3	.0280	0287	0293	0300	0307	0313	0320	0326	0333	0339	0346	0352	0359	0365	
6	.0277	0284	0291	0297	0304	0310	0317	0323	0330	0336	0342	0349	0355	0362	
9	.0275	0281	0288	0294	0301	0307	0313	0320	0326	0333	0339	0345	0352	0358	
12	.0272	0279	0285	0291	0298	0304	0310	0317	0323	0330	0336	0342	0349	0355	
5 15	.0270	0276	0282	0289	0295	0301	0308	0314	0320	0326	0333	0339	0345	0351	
18	.0267	0273	0280	0286	0292	0298	0305	0311	0317	0323	0330	0336	0342	0348	
21	.0264	0271	0277	0283	0289	0296	0302	0308	0314	0320	0327	0333	0339	0345	
24	.0262	0268	0274	0281	0287	0293	0299	0305	0311	0317	0324	0330	0336	0342	
27	.0260	0266	0272	0278	0284	0290	0296	0302	0308	0314	0321	0327	0333	0339	
5 30	.0257	0263	0269	0275	0282	0288	0294	0300	0306	0312	0318	0324	0330	0336	
33	.0255	0261	0267	0273	0279	0285	0291	0297	0303	0309	0315	0321	0327	0333	
36	.0253	0259	0265	0271	0276	0282	0288	0294	0300	0306	0312	0318	0324	0330	
39		0256	0262	0268	0274	0280	0286	0292	0298	0303	0309	0315	0321	0327	
42		0254	0260	0266	0272	0277	0283	0289	0295	0301	0306	0312	0318	0324	
5 45		0252	0258	0263	0269	0275	0281	0287	0292	0298	0304	0310	0315	0321	
48		0250	0255	0261	0267	0273	0278	0284	0290	0295	0301	0307	0313	0318	
51		0247	0253	0259	0265	0270	0276	0282	0287	0293	0299	0304	0310	0316	
54		0245	0251	0257	0262	0268	0274	0279	0285	0290	0296	0302	0307	0313	
57		0243	0249	0254	0260	0266	0271	0277	0282	0288	0294	0299	0305	0310	
6 0		0241	0247	0252	0258	0263	0269	0275	0280	0286	0291	0297	0302	0308	
3		0239	0245	0250	0256	0261	0267	0272	0278	0283	0289	0294	0300	0305	
6		0237	0243	0248	0254	0259	0265	0270	0275	0281	0286	0292	0297	0302	
9		0235	0241	0246	0252	0257	0262	0268	0273	0279	0284	0289	0295	0300	
12		0233	0239	0244	0249	0255	0260	0266	0271	0276	0282	0287	0292	0298	
6 15		0231	0237	0242	0247	0253	0258	0263	0269	0274	0279	0285	0290	0295	
18		0230	0235	0240	0245	0251	0256	0261	0267	0272	0277	0282	0288	0293	
21		0228	0233	0238	0243	0249	0254	0259	0264	0270	0275	0280	0285	0290	
24		0226	0231	0236	0242	0247	0252	0257	0262	0267	0273	0278	0283	0288	
27			0229	0234	0240	0245	0250	0255	0260	0265	0271	0276	0281	0286	0291
6 30			0227	0233	0238	0243	0248	0253	0258	0263	0268	0274	0279	0284	0289
33			0226	0231	0236	0241	0246	0251	0256	0261	0266	0271	0276	0281	0287
36			0224	0229	0234	0239	0244	0249	0254	0259	0264	0269	0274	0279	0284
39			0222	0227	0232	0237	0242	0247	0252	0257	0262	0267	0272	0277	0282
42			0220	0225	0230	0235	0240	0245	0250	0255	0260	0265	0270	0275	0280
6 45			0219	0224	0229	0234	0239	0244	0248	0253	0258	0263	0268	0273	0278
48			0217	0222	0227	0232	0237	0242	0247	0251	0256	0261	0266	0271	0276
51			0216	0220	0225	0230	0235	0240	0245	0250	0254	0259	0264	0269	0274
54			0214	0219	0224	0228	0233	0238	0243	0248	0253	0257	0262	0267	0272
57			0212	0217	0222	0227	0232	0236	0241	0246	0251	0255	0260	0265	0270
7 0			0211	0216	0220	0225	0230	0235	0239	0244	0249	0254	0258	0263	0268
3			0209	0214	0219	0223	0228	0233	0238	0242	0247	0252	0256	0261	0266
6			0208	0212	0217	0222	0227	0231	0236	0241	0245	0250	0255	0259	0264
9				0211	0216	0220	0225	0230	0234	0239	0243	0248	0253	0257	0262
12				0209	0214	0219	0223	0228	0232	0237	0242	0246	0251	0255	0260
7 15				0208	0212	0217	0222	0226	0231	0235	0240	0245	0249	0254	0258
18				0206	0211	0216	0220	0225	0229	0234	0238	0243	0247	0252	0256
21				0205	0209	0214	0219	0223	0228	0232	0237	0241	0246	0250	0255
24				0204	0208	0213	0217	0222	0226	0230	0235	0239	0244	0248	0253
27				0202	0207	0211	0216	0220	0224	0229	0233	0238	0242	0247	0251
7 30				0201	0205	0210	0214	0218	0223	0227	0232	0236	0241	0245	0249
33				0199	0204	0208	0213	0217	0221	0226	0230	0234	0239	0243	0248
36				0198	0202	0207	0211	0215	0220	0224	0229	0233	0237	0242	0246
39				0197	0201	0205	0210	0214	0218	0223	0227	0231	0236	0240	0244
42				0195	0200	0204	0208	0213	0217	0221	0225	0230	0234	0238	0243
7 45				0194	0198	0203	0207	0211	0215	0220	0224	0228	0232	0237	0241
48				0193	0197	0201	0205	0210	0214	0218	0222	0227	0231	0235	0239
51				0191	0196	0200	0204	0208	0213	0217	0221	0225	0229	0234	0238
54				0190	0194	0198	0203	0207	0211	0215	0219	0224	0228	0232	0236
57				0189	0193	0197	0201	0206	0210	0214	0218	0222	0226	0230	0235
8 0				0188	0192	0196	0200	0204	0208	0212	0217	0221	0225	0229	0233

TABLE V. LOG. D.

Logs. A, B, C, and D, for Lunars.

App. Alt. of D.	REDUCED PARALLAX AND REFRACTION OF D.															
	45'	46'	47'	48'	49'	50'	51'	52'	53'	54'	55'	56'	57'	58'		
8° 0'	.0192	.0196	.0200	.0204	.0208	.0212	.0217	.0221	.0225	.0229	.0233	.0237				
5	.0190	.0194	.0198	.0202	.0206	.0210	.0214	.0218	.0222	.0227	.0231	.0235				
10	.0188	.0192	.0196	.0200	.0204	.0208	.0212	.0216	.0220	.0224	.0228	.0232				
15	.0186	.0190	.0194	.0198	.0202	.0206	.0210	.0214	.0218	.0222	.0226	.0230				
20	.0184	.0188	.0192	.0196	.0200	.0204	.0207	.0211	.0215	.0219	.0223	.0227				
25	.0182	.0186	.0190	.0194	.0197	.0201	.0205	.0209	.0213	.0217	.0221	.0225				
30	.0180	.0184	.0188	.0192	.0195	.0199	.0203	.0207	.0211	.0215	.0219	.0223				
35	.0178	.0182	.0186	.0190	.0193	.0197	.0201	.0205	.0209	.0213	.0216	.0220				
40	.0176	.0180	.0184	.0188	.0191	.0195	.0199	.0203	.0207	.0210	.0214	.0218				
45	.0174	.0178	.0182	.0186	.0189	.0193	.0197	.0201	.0205	.0208	.0212	.0216				
50	.0173	.0176	.0180	.0184	.0188	.0191	.0195	.0199	.0202	.0206	.0210	.0214				
55	.0171	.0175	.0178	.0182	.0186	.0189	.0193	.0197	.0200	.0204	.0208	.0212				
9 0	.0169	.0173	.0177	.0180	.0184	.0188	.0191	.0195	.0198	.0202	.0206	.0209				
5	.0167	.0171	.0175	.0178	.0182	.0186	.0189	.0193	.0197	.0200	.0204	.0207				
10	.0166	.0169	.0173	.0177	.0180	.0184	.0187	.0191	.0195	.0198	.0202	.0205				
15	.0164	.0168	.0171	.0175	.0179	.0182	.0186	.0189	.0193	.0196	.0200	.0203				
20	.0163	.0166	.0170	.0173	.0177	.0180	.0184	.0187	.0191	.0194	.0198	.0201				
25	.0161	.0165	.0168	.0172	.0175	.0179	.0182	.0186	.0189	.0193	.0196	.0199				
30		.0163	.0166	.0170	.0173	.0177	.0180	.0184	.0187	.0191	.0194	.0198				
35		.0161	.0165	.0168	.0172	.0175	.0179	.0182	.0185	.0189	.0192	.0196				
40		.0160	.0163	.0167	.0170	.0174	.0177	.0180	.0184	.0187	.0191	.0194				
45		.0158	.0162	.0165	.0169	.0172	.0175	.0179	.0182	.0185	.0189	.0192	.0195			
50		.0157	.0160	.0164	.0167	.0170	.0174	.0177	.0180	.0184	.0187	.0190	.0194			
55		.0156	.0159	.0162	.0165	.0169	.0172	.0175	.0179	.0182	.0185	.0189	.0192			
10 0		.0154	.0157	.0161	.0164	.0167	.0171	.0174	.0177	.0180	.0184	.0187	.0190			
5		.0153	.0156	.0159	.0162	.0166	.0169	.0172	.0175	.0179	.0182	.0185	.0188			
10		.0151	.0155	.0158	.0161	.0164	.0167	.0171	.0174	.0177	.0180	.0183	.0187			
15		.0150	.0153	.0156	.0160	.0163	.0166	.0169	.0172	.0175	.0179	.0182	.0185			
20		.0149	.0152	.0155	.0158	.0161	.0164	.0168	.0171	.0174	.0177	.0180	.0183			
25		.0147	.0150	.0154	.0157	.0160	.0163	.0166	.0169	.0172	.0175	.0179	.0182			
30		.0146	.0149	.0152	.0155	.0158	.0162	.0165	.0168	.0171	.0174	.0177	.0180			
35		.0145	.0148	.0151	.0154	.0157	.0160	.0163	.0166	.0169	.0172	.0175	.0179			
40		.0143	.0147	.0150	.0153	.0156	.0159	.0162	.0165	.0168	.0171	.0174	.0177			
45		.0142	.0145	.0148	.0151	.0154	.0157	.0160	.0163	.0166	.0169	.0172	.0175			
50		.0141	.0144	.0147	.0150	.0153	.0156	.0159	.0162	.0165	.0168	.0171	.0174			
55		.0140	.0143	.0146	.0149	.0152	.0155	.0158	.0161	.0164	.0167	.0170	.0172			
11 0		.0139	.0142	.0145	.0147	.0150	.0153	.0156	.0159	.0162	.0165	.0168	.0171			
5		.0137	.0140	.0143	.0146	.0149	.0152	.0155	.0158	.0161	.0164	.0167	.0170			
10			.0139	.0142	.0145	.0148	.0151	.0154	.0157	.0159	.0162	.0165	.0168			
15			.0138	.0141	.0144	.0147	.0150	.0152	.0155	.0158	.0161	.0164	.0167			
20			.0137	.0140	.0143	.0145	.0148	.0151	.0154	.0157	.0160	.0163	.0165			
25			.0136	.0139	.0141	.0144	.0147	.0150	.0153	.0156	.0158	.0161	.0164			
30			.0135	.0137	.0140	.0143	.0146	.0149	.0151	.0154	.0157	.0160	.0163			
35			.0133	.0136	.0139	.0142	.0145	.0147	.0150	.0153	.0156	.0159	.0161			
40			.0132	.0135	.0138	.0141	.0143	.0146	.0149	.0152	.0154	.0157	.0160			
45			.0131	.0134	.0137	.0140	.0142	.0145	.0148	.0150	.0153	.0156	.0159			
50			.0130	.0133	.0136	.0138	.0141	.0144	.0147	.0149	.0152	.0155	.0157			
55			.0129	.0132	.0135	.0137	.0140	.0143	.0145	.0148	.0151	.0153	.0156			
12 0			.0128	.0131	.0134	.0136	.0139	.0142	.0144	.0147	.0150	.0152	.0155			
5			.0127	.0130	.0132	.0135	.0138	.0140	.0143	.0146	.0148	.0151	.0154			
10			.0126	.0129	.0131	.0134	.0137	.0139	.0142	.0145	.0147	.0150	.0152			
15			.0125	.0128	.0130	.0133	.0136	.0138	.0141	.0143	.0146	.0149	.0151			
20			.0124	.0127	.0129	.0132	.0135	.0137	.0140	.0142	.0145	.0147	.0150			
25			.0123	.0126	.0128	.0131	.0133	.0136	.0139	.0141	.0144	.0146	.0149			
30			.0122	.0125	.0127	.0130	.0132	.0135	.0138	.0140	.0143	.0145	.0148			
35			.0121	.0124	.0126	.0129	.0131	.0134	.0136	.0139	.0141	.0144	.0147			
40			.0120	.0123	.0125	.0128	.0130	.0133	.0135	.0138	.0140	.0143	.0145			
45			.0119	.0122	.0124	.0127	.0129	.0132	.0134	.0137	.0139	.0142	.0144	.0147		
50			.0118	.0121	.0123	.0126	.0128	.0131	.0133	.0136	.0138	.0141	.0143	.0146		
55			.0118	.0120	.0123	.0125	.0127	.0130	.0132	.0135	.0137	.0140	.0142	.0145		
13 0			.0117	.0119	.0122	.0124	.0126	.0129	.0131	.0134	.0136	.0139	.0141	.0143		

TABLE V. LOG. D.

Logs. A, B, C, and D, for Lunars.

App. Alt. of D.		REDUCED PARALLAX AND REFRACTION OF D.														
		47'	48'	49'	50'	51'	52'	53'	54'	55'	56'	57'	58'	59'		
13°	0'	.0117	.0119	.0122	.0124	.0126	.0129	.0131	.0134	.0136	.0139	.0141	.0143			
	10	.0115	.0117	.0120	.0122	.0125	.0127	.0129	.0132	.0134	.0137	.0139	.0141			
	20	.0113	.0116	.0118	.0120	.0123	.0125	.0127	.0130	.0132	.0134	.0137	.0139			
	30	.0112	.0114	.0116	.0119	.0121	.0123	.0125	.0128	.0130	.0132	.0135	.0137			
	40		.0112	.0114	.0117	.0119	.0121	.0124	.0126	.0128	.0131	.0133	.0135			
	50		.0111	.0113	.0115	.0117	.0120	.0122	.0124	.0126	.0129	.0131	.0133			
14	0		.0109	.0111	.0113	.0116	.0118	.0120	.0122	.0125	.0127	.0129	.0131			
	10		.0107	.0110	.0112	.0114	.0116	.0118	.0121	.0123	.0125	.0127	.0129			
	20		.0106	.0108	.0110	.0112	.0114	.0117	.0119	.0121	.0123	.0125	.0127			
	30		.0104	.0106	.0109	.0111	.0113	.0115	.0117	.0119	.0121	.0123	.0126			
	40		.0103	.0105	.0107	.0109	.0111	.0113	.0115	.0118	.0120	.0122	.0124			
	50		.0101	.0103	.0106	.0108	.0110	.0112	.0114	.0116	.0118	.0120	.0122			
15	0		.0100	.0102	.0104	.0106	.0108	.0110	.0112	.0114	.0116	.0118	.0120			
	10		.0099	.0101	.0103	.0105	.0107	.0109	.0111	.0113	.0115	.0117	.0119			
	20		.0097	.0099	.0101	.0103	.0105	.0107	.0109	.0111	.0113	.0115	.0117			
	30		.0096	.0098	.0100	.0102	.0104	.0106	.0108	.0110	.0112	.0113	.0115			
	40		.0094	.0096	.0098	.0100	.0102	.0104	.0106	.0108	.0110	.0112	.0114			
	50		.0093	.0095	.0097	.0099	.0101	.0103	.0105	.0107	.0108	.0110	.0112			
16	0		.0092	.0094	.0096	.0098	.0099	.0101	.0103	.0105	.0107	.0109	.0111			
	10		.0091	.0093	.0094	.0096	.0098	.0100	.0102	.0104	.0106	.0107	.0109			
	20		.0089	.0091	.0093	.0095	.0097	.0099	.0100	.0102	.0104	.0106	.0108			
	30		.0088	.0090	.0092	.0094	.0096	.0097	.0099	.0101	.0103	.0105	.0106			
	40		.0087	.0089	.0091	.0092	.0094	.0096	.0098	.0100	.0101	.0103	.0105			
	50		.0086	.0088	.0089	.0091	.0093	.0095	.0096	.0098	.0100	.0102	.0104			
17	0		.0085	.0087	.0088	.0090	.0092	.0093	.0095	.0097	.0099	.0100	.0102			
	10		.0084	.0085	.0087	.0089	.0091	.0092	.0094	.0096	.0097	.0099	.0101			
	20		.0083	.0084	.0086	.0088	.0089	.0091	.0093	.0094	.0096	.0098	.0099			
	30		.0083	.0085	.0086	.0088	.0090	.0091	.0093	.0095	.0096	.0098	.0098			
	40		.0082	.0084	.0085	.0087	.0089	.0090	.0092	.0094	.0095	.0097	.0097			
	50		.0081	.0083	.0084	.0086	.0087	.0089	.0091	.0092	.0094	.0096	.0096			
18	0		.0080	.0082	.0083	.0085	.0086	.0088	.0090	.0091	.0093	.0094				
	10		.0078	.0079	.0081	.0083	.0084	.0086	.0087	.0089	.0090	.0092	.0093			
	20		.0076	.0077	.0079	.0080	.0082	.0083	.0085	.0087	.0088	.0090	.0091			
19	0		.0074	.0075	.0077	.0078	.0080	.0081	.0083	.0084	.0086	.0087	.0089			
	10		.0072	.0073	.0075	.0076	.0078	.0079	.0081	.0082	.0084	.0085	.0086			
	20		.0070	.0072	.0073	.0074	.0076	.0077	.0079	.0080	.0081	.0083	.0084			
	30		.0068	.0070	.0071	.0073	.0074	.0075	.0077	.0078	.0079	.0081	.0082			
	40		.0067	.0068	.0069	.0071	.0072	.0073	.0075	.0076	.0077	.0079	.0080			
	50		.0065	.0066	.0068	.0069	.0070	.0072	.0073	.0074	.0075	.0077	.0078			
21	0		.0063	.0065	.0066	.0067	.0068	.0070	.0071	.0072	.0074	.0075	.0076			
	10		.0062	.0063	.0064	.0065	.0067	.0068	.0069	.0070	.0072	.0073	.0074			
	20		.0060	.0061	.0063	.0064	.0065	.0066	.0067	.0069	.0070	.0071	.0072			
	30		.0059	.0060	.0061	.0062	.0063	.0065	.0066	.0067	.0068	.0069	.0070			
	40		.0057	.0058	.0059	.0061	.0062	.0063	.0064	.0065	.0066	.0068	.0069			
	50		.0056	.0057	.0058	.0059	.0060	.0061	.0062	.0064	.0065	.0066	.0067			
23	0		.0054	.0055	.0057	.0058	.0059	.0060	.0061	.0062	.0063	.0064	.0065			
	10		.0053	.0054	.0055	.0056	.0057	.0058	.0059	.0060	.0061	.0063	.0064			
	20		.0052	.0053	.0054	.0055	.0056	.0057	.0058	.0059	.0060	.0061	.0062			
	30		.0050	.0051	.0052	.0053	.0054	.0055	.0056	.0057	.0058	.0059	.0060			
	40		.0049	.0050	.0051	.0052	.0053	.0053	.0054	.0055	.0056	.0057	.0058			
25	0		.0047	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056	.0057			
	10		.0046	.0047	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056			
	20		.0045	.0046	.0047	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055			
	30		.0044	.0045	.0046	.0046	.0047	.0048	.0049	.0050	.0051	.0052	.0053			
26	0		.0043	.0043	.0044	.0045	.0046	.0047	.0048	.0048	.0049	.0050	.0051			
	10		.0041	.0042	.0043	.0044	.0045	.0046	.0047	.0048	.0048	.0049	.0050			
	20		.0040	.0041	.0042	.0043	.0044	.0044	.0045	.0046	.0047	.0047	.0047			
	30		.0039	.0040	.0041	.0042	.0042	.0043	.0044	.0045	.0045	.0046	.0046			
	40		.0038	.0039	.0040	.0040	.0041	.0042	.0043	.0043	.0044	.0044	.0045			
28	0		.0037	.0038	.0039	.0039	.0040	.0041	.0042	.0042	.0043	.0044	.0044			

TABLE V. LOG. D.

Logs. A, B, C, and D, for Lunars.

Apparent Altitude of D.	REDUCED PARALLAX AND REFRACTION OF D.											
	50'	51'	52'	53'	54'	55'	56'	57'	58'	59'	60'	
28° 0'	0.0037	0.0038	0.0039	0.0039	0.0040	0.0041	0.0042	0.0042	0.0043	0.0044		
30	0.0036	0.0036	0.0037	0.0038	0.0038	0.0039	0.0040	0.0040	0.0041	0.0042		
29 0	0.0034	0.0035	0.0035	0.0036	0.0037	0.0037	0.0038	0.0039	0.0039	0.0040		
30	0.0033	0.0033	0.0034	0.0035	0.0035	0.0036	0.0036	0.0037	0.0038	0.0038		
30 0	0.0031	0.0032	0.0032	0.0033	0.0034	0.0034	0.0035	0.0035	0.0036	0.0037		
30	0.0030	0.0030	0.0031	0.0031	0.0032	0.0033	0.0033	0.0034	0.0034	0.0035		
31 0	0.0028	0.0029	0.0029	0.0030	0.0031	0.0031	0.0032	0.0032	0.0033	0.0033		
30	0.0027	0.0028	0.0028	0.0029	0.0029	0.0030	0.0030	0.0031	0.0031	0.0032	0.0032	
32 0	0.0026	0.0026	0.0027	0.0027	0.0028	0.0028	0.0029	0.0029	0.0030	0.0030	0.0031	
30	0.0024	0.0025	0.0025	0.0026	0.0026	0.0027	0.0027	0.0028	0.0028	0.0029	0.0029	
33 0	0.0023	0.0024	0.0024	0.0025	0.0025	0.0025	0.0026	0.0026	0.0027	0.0027	0.0028	
30	0.0022	0.0022	0.0023	0.0023	0.0024	0.0024	0.0025	0.0025	0.0025	0.0026	0.0026	
34 0	0.0021	0.0021	0.0022	0.0022	0.0022	0.0023	0.0023	0.0024	0.0024	0.0024	0.0025	
30	0.0020	0.0020	0.0020	0.0021	0.0021	0.0022	0.0022	0.0022	0.0023	0.0023	0.0023	
35 0	0.0018	0.0019	0.0019	0.0020	0.0020	0.0020	0.0021	0.0021	0.0021	0.0022	0.0022	
30	0.0017	0.0018	0.0018	0.0018	0.0019	0.0019	0.0019	0.0020	0.0020	0.0020	0.0021	
36 0	0.0016	0.0017	0.0017	0.0017	0.0018	0.0018	0.0018	0.0019	0.0019	0.0019	0.0019	
30	0.0015	0.0016	0.0016	0.0016	0.0016	0.0017	0.0017	0.0017	0.0018	0.0018	0.0018	
37 0	0.0014	0.0014	0.0015	0.0015	0.0015	0.0016	0.0016	0.0016	0.0016	0.0017	0.0017	
30	0.0013	0.0013	0.0014	0.0014	0.0014	0.0014	0.0015	0.0015	0.0015	0.0015	0.0016	
38 0	0.0012	0.0012	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0014	0.0014	
30	0.0011	0.0011	0.0012	0.0012	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0013	
39 0	0.0010	0.0010	0.0011	0.0011	0.0011	0.0011	0.0011	0.0012	0.0012	0.0012	0.0012	
30	0.0009	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0011	0.0011	0.0011	
40	0.0008	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0010	0.0010	0.0010	
41	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0008	0.0008	
42	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0006	
43	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0004	
44	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	
45	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
46	9.9998	9.9998	9.9998	9.9998	9.9998	9.9998	9.9998	9.9998	9.9998	9.9998	9.9998	
47	9.9997	9.9997	9.9997	9.9997	9.9997	9.9996	9.9996	9.9996	9.9996	9.9996	9.9996	
48	9.9995	9.9995	9.9995	9.9995	9.9995	9.9995	9.9995	9.9995	9.9995	9.9994	9.9994	
49	9.9994	9.9994	9.9994	9.9994	9.9993	9.9993	9.9993	9.9993	9.9993	9.9993	9.9993	
50	9.9992	9.9992	9.9992	9.9992	9.9992	9.9992	9.9992	9.9992	9.9991	9.9991	9.9991	
51	9.9991	9.9991	9.9991	9.9991	9.9990	9.9990	9.9990	9.9990	9.9990	9.9990	9.9990	
52	9.9990	9.9990	9.9990	9.9989	9.9989	9.9989	9.9989	9.9989	9.9989	9.9988	9.9988	
53	9.9989	9.9988	9.9988	9.9988	9.9988	9.9988	9.9988	9.9987	9.9987	9.9987	9.9987	
54	9.9988	9.9987	9.9987	9.9987	9.9987	9.9987	9.9986	9.9986	9.9986	9.9986	9.9985	
55	9.9986	9.9986	9.9986	9.9986	9.9985	9.9985	9.9985	9.9985	9.9984	9.9984	9.9984	
56	9.9985	9.9985	9.9985	9.9984	9.9984	9.9984	9.9984	9.9984	9.9983	9.9983	9.9983	
57	9.9984	9.9984	9.9984	9.9983	9.9983	9.9983	9.9983	9.9982	9.9982	9.9982	9.9981	
58	9.9983	9.9983	9.9983	9.9982	9.9982	9.9982	9.9982	9.9981	9.9981	9.9981	9.9980	
59	9.9982	9.9982	9.9981	9.9981	9.9981	9.9981	9.9980	9.9980	9.9980	9.9979	9.9979	
60	9.9981	9.9981	9.9980	9.9980	9.9980	9.9980	9.9979	9.9979	9.9979	9.9978	9.9978	
61	9.9980	9.9980	9.9980	9.9979	9.9979	9.9979	9.9978	9.9978	9.9978	9.9977	9.9977	
62	9.9979	9.9979	9.9979	9.9978	9.9978	9.9978	9.9977	9.9977	9.9977	9.9976	9.9976	
63	9.9979	9.9978	9.9978	9.9977	9.9977	9.9977	9.9976	9.9976	9.9976	9.9975	9.9975	
64	9.9978	9.9977	9.9977	9.9976	9.9976	9.9976	9.9976	9.9975	9.9975	9.9974	9.9974	
65	9.9977	9.9977	9.9976	9.9976	9.9976	9.9975	9.9975	9.9974	9.9974	9.9973	9.9972	
66	9.9976	9.9976	9.9975	9.9975	9.9974	9.9974	9.9974	9.9973	9.9973	9.9973	9.9972	
67	9.9976	9.9975	9.9975	9.9974	9.9974	9.9974	9.9973	9.9973	9.9972	9.9972	9.9971	
68	9.9975	9.9974	9.9974	9.9973	9.9973	9.9973	9.9972	9.9972	9.9971	9.9971	9.9970	
69	9.9974	9.9974	9.9973	9.9973	9.9972	9.9972	9.9972	9.9971	9.9971	9.9970	9.9970	
70	9.9974	9.9973	9.9973	9.9972	9.9972	9.9972	9.9971	9.9970	9.9970	9.9969	9.9969	
72	9.9972	9.9972	9.9971	9.9971	9.9970	9.9970	9.9970	9.9969	9.9969	9.9968	9.9968	
74	9.9971	9.9971	9.9970	9.9970	9.9969	9.9969	9.9969	9.9968	9.9968	9.9967	9.9966	
76	9.9971	9.9970	9.9969	9.9969	9.9968	9.9968	9.9967	9.9967	9.9966	9.9966	9.9965	
78	9.9970	9.9969	9.9969	9.9968	9.9967	9.9967	9.9967	9.9966	9.9966	9.9965	9.9964	
80	9.9969	9.9969	9.9968	9.9967	9.9967	9.9967	9.9966	9.9965	9.9965	9.9964	9.9964	
90	9.9968	9.9967	9.9966	9.9966	9.9965	9.9965	9.9964	9.9964	9.9963	9.9963	9.9962	

Second Correction of the Lunar Distance.

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TABLE VI.

Second Correction of the Lunar Distance.

FIRST CORRECTION OF DISTANCE.																									Appar- ent Dis- tance.
Appar- ent Dis- tance.	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	
Subtr.																									Add.
15° 0'	45	47	50	52	55	57	60	63	66	69	72	75	78	81	85	88	91	95	99	102	106	110	113	117	
30	43	45	48	50	53	56	58	61	64	67	70	72	76	79	82	85	88	92	95	99	102	106	110	113	
16 0	42	44	46	49	51	54	56	59	62	64	67	70	73	76	79	82	85	89	92	95	99	102	106	110	
30	40	43	45	47	50	52	54	57	60	62	65	68	71	74	77	80	83	86	89	92	96	99	103	106	
17 0	39	41	43	46	48	50	53	55	58	60	63	66	69	71	74	77	80	83	86	90	93	96	99	103	
30	38	40	42	44	47	49	51	54	56	59	61	64	66	69	72	75	78	81	84	87	90	93	96	100	
18 0	37	39	41	43	45	47	50	52	54	57	59	62	64	67	70	73	75	78	81	84	87	90	94	97	
30	36	38	40	42	44	46	48	50	53	55	58	60	63	65	68	71	73	76	79	82	85	88	91	94	
19 0	35	37	39	41	43	45	47	49	51	54	56	58	61	63	66	69	71	74	77	79	82	85	88	91	
30	34	36	37	39	41	43	46	48	50	52	54	57	59	62	64	67	69	72	75	77	80	83	86	89	
20	33	35	36	38	40	42	44	46	49	51	53	55	58	60	62	65	67	70	73	75	78	81	83	86	
21	31	33	35	36	38	40	42	44	46	48	50	52	55	57	59	61	64	66	69	71	74	76	79	82	
22	30	31	33	35	36	38	40	42	44	46	48	50	52	54	56	58	61	63	65	68	70	73	75	78	
23	28	30	31	33	35	36	38	40	42	44	45	47	49	51	53	56	58	60	62	64	67	69	72	74	
24	27	28	30	31	33	35	36	38	40	41	43	45	47	49	51	53	55	57	59	61	64	66	68	71	
25	26	27	28	30	31	33	35	36	38	40	41	43	45	47	49	51	53	55	57	59	61	63	65	67	
26	25	26	27	29	30	32	33	35	36	38	40	41	43	45	47	48	50	52	54	56	58	60	62	64	
27	23	25	26	27	29	30	32	33	35	36	38	39	41	43	45	46	48	50	52	54	56	58	60	62	
28	22	24	25	26	28	29	30	32	33	35	36	38	39	41	43	44	46	48	50	51	53	55	57	59	
29	22	23	24	25	26	28	29	30	32	33	35	36	38	39	41	43	44	46	48	49	51	53	55	57	
30	21	22	23	24	25	27	28	29	31	32	33	35	36	38	39	41	42	44	46	47	49	51	53	54	
31	20	21	22	23	24	26	27	28	29	31	32	33	35	36	38	39	41	42	44	46	47	49	51	52	
32	19	20	21	22	23	25	26	27	28	30	31	32	34	35	36	38	39	41	42	44	45	47	49	50	
33	18	19	20	22	23	24	25	26	27	28	30	31	32	34	35	36	38	39	41	42	44	45	47	48	
34	18	19	20	21	22	23	24	25	26	27	29	30	31	32	34	35	36	38	39	41	42	44	45	47	
35	17	18	19	20	21	22	23	24	25	26	28	29	30	31	32	34	35	36	38	39	40	42	43	45	
36	16	17	18	19	20	21	22	23	24	25	27	28	29	30	31	32	34	35	36	38	39	40	42	43	
37	16	17	18	19	19	20	21	22	23	25	26	27	28	29	30	31	33	34	35	36	38	39	40	42	
38	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	33	34	35	36	38	39	40	
39	15	16	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	33	34	35	36	38	39	
40	14	15	16	17	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	33	34	35	36	37	140°
42	13	14	15	16	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	33	34	35	36	138
44	12	13	14	14	15	16	17	17	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	33	136
46	12	12	13	13	14	15	16	16	17	18	19	19	20	21	22	23	24	25	26	26	27	28	29	30	134
48	11	11	12	13	13	14	15	15	16	17	17	18	19	20	20	21	22	23	24	25	26	26	27	28	132
50	10	11	11	12	12	13	14	14	15	16	16	17	18	18	19	20	21	21	22	23	24	25	25	26	130
52	9	10	10	11	11	12	13	13	14	14	15	16	16	17	18	18	19	20	21	21	22	23	24	25	128
54	9	9	10	10	11	11	12	12	13	13	14	15	15	16	16	17	18	18	19	20	21	21	22	23	126
56	8	9	9	9	10	10	11	11	12	12	13	14	14	15	15	16	17	17	18	18	19	20	20	21	124
58	7	8	8	8	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	18	18	19	20	122
60	7	7	8	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	18	18	120
62	6	7	7	7	8	8	9	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	17	17	118
64	6	6	6	7	7	8	8	8	9	9	10	10	10	11	11	12	12	12	13	13	14	14	15	15	116
66	5	6	6	6	7	7	7	8	8	8	9	9	9	10	10	11	11	11	12	12	13	13	14	14	114
68	5	5	5	6	6	6	7	7	7	7	8	8	8	9	9	10	10	10	11	11	11	12	12	13	112
70	4	5	5	5	5	6	6	6	6	7	7	7	8	8	8	9	9	9	10	10	10	11	11	11	110
74	3	4	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	9	9	9	106
78	3	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	6	6	6	6	6	7	102
82	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	98
86	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	94
90°	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90°
Appar- ent Dis- tance.	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	Appar- ent Dis- tance.
FIRST CORRECTION OF DISTANCE.																									

TABLE VII.

For finding the Correction of the Lunar Distance for the Contraction of the Moon's Semidiameter.

TABLE VII. A. GIVING THE ARGUMENT FOR TABLE VII. B.

Reduced P. and R. of $\odot$.	APPARENT ALTITUDE OF $\odot$.																			
	5	5 $\frac{1}{2}$	6	6 $\frac{1}{2}$	7	7 $\frac{1}{2}$	8	8 $\frac{1}{2}$	9	9 $\frac{1}{2}$	10	11	12	13	14	15	16	17	18	20
41'	65	56																		
42	63	54	47	41																
43	62	53	46	40	35															
44	60	51	45	39	34	30	27													
45	58	50	43	38	33	30	26	24	21	20										
46	57	49	42	37	33	29	26	23	21	19	17	15								
47	56	48	41	36	32	28	25	23	20	19	17	14	12	10						
48	54	46	40	35	31	28	25	22	20	18	17	14	12	10	9	8	7	6		
49	53	45	39	35	30	27	24	22	19	18	16	14	12	10	9	8	7	6	5	3
50	52	44	38	34	30	26	24	21	19	17	16	13	11	10	9	8	7	6	5	3
51	50	43	38	33	29	26	23	21	19	17	15	13	11	10	8	7	7	6	5	3
52	49	42	37	32	28	25	23	20	18	17	15	13	11	9	8	7	7	6	5	3
53	48	41	36	32	28	25	22	20	18	16	15	12	11	9	8	7	6	6	5	3
54	47	41	35	31	27	24	22	19	18	16	15	12	10	9	8	7	6	6	5	3
55			35	30	27	24	21	19	17	16	14	12	10	9	8	7	6	6	5	3
56					26	23	21	19	17	15	14	12	10	9	8	7	6	5	5	4
57								18	17	15	14	12	10	9	7	7	6	5	5	4
58											13	11	10	8	7	7	6	5	5	4
59													8	7	6	6	5	5	4	3
60														8	7	6	6	5	5	4

TABLE VII. B. CONTRACTION OF $\odot$ 'S SEMIDIAMETER.

Whole Correction of $\odot$.	ARGUMENT = NUMBER FROM TABLE VII. A																									
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	44	48	52	56	60	64
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
15	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3
20	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	4	4	4	4	5	5
22	0	0	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	4	4	4	5	5	5	6	6
24	0	0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	6	6	6	7	7
26	0	1	1	1	1	2	2	2	2	3	3	3	4	4	4	4	5	5	5	6	6	7	7	8	8	9
28	0	1	1	1	2	2	2	3	3	3	3	4	4	4	5	5	5	6	6	6	7	8	8	9	9	10
30	0	1	1	1	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	8	9	9	10	11	12
32	0	1	1	2	2	2	3	3	4	4	5	5	5	6	6	7	7	7	8	8	9	10	11	11	12	13
34	0	1	1	2	2	3	3	4	4	5	5	6	6	6	7	7	8	8	9	9	10	11	12	13	14	15
36	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	12	13	15	16	17
38	1	1	2	2	3	3	4	5	5	6	6	7	8	8	9	9	10	10	11	12	13	14	15	16	17	18
40	1	1	2	3	3	4	4	5	6	6	7	8	8	9	9	10	11	12	12	13	14	15	17	18	19	20
42	1	1	2	3	4	4	5	6	6	7	8	8	9	10	11	11	12	13	13	14	16	17	18	20	21	23
44	1	2	2	3	4	5	5	6	7	8	9	9	10	11	12	12	13	14	15	15	17	19	20	22	23	
45	1	2	2	3	4	5	6	6	7	8	9	10	11	11	12	13	14	15	15	16	18	19	21	23	24	
46	1	2	3	3	4	5	6	7	7	8	9	10	11	12	13	14	14	15	16	17	19	20	22	24		
47	1	2	3	4	4	5	6	7	8	9	10	11	11	12	13	14	15	16	17	18	19	21	23	25		
48	1	2	3	4	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	18	20	22	24	26		
49	1	2	3	4	5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	21	23	25			
50	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	22	24	26			
51	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	23	25	27			
52	1	2	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	21	22	24	26				
53	1	2	3	4	6	7	8	9	10	11	12	13	15	16	17	18	19	20	21	22	25	27				
54		2	3	5	6	7	8	9	10	12	13	14	15	16	17	19	20	21	22	23	26					
55		2	4	5	6	7	8	10	11	12	13	15	16	17	18	19	21	22								
56		3	4	5	6	8	9	10	11	13	14	15	16													
57		4	5	7																						

When the nearest limb is observed subtract this correction; when the farthest, add.

TABLE VIII.

For finding the Correction of the Lunar Distance for the Contraction of the Sun's Semidiameter.

TABLE VIII. A. GIVING THE ARGUMENT FOR TABLE VIII. B.

Reduced P. and R. of ☉.	APPARENT ALTITUDE OF ☉.																			
	5	5½	6	6½	7	7½	8	8½	9	9½	10	11	12	13	14	15	16	17	18	20
1' 0"																				22 18
30																			30 34	24 29
2 0																			35 37	42 46
30																			42 47	46 46
3 0															44 46		40 49	42 51	53 57	
30													45 48	51 54	57 60	62 67				
4 0											45 49	51 55	52 55	59 63	66 70		65 68			
30									47 50	52 54	57 61	66 70								
5 0																				
30					47 50	52 55	57 60	63 66	68 74											
6 0				49 52	55 56	59 62	65 68	71 74												
30			50 53	56 59	62 65	68 71	74													
7 0		51 55	54 58	61 64	67 70	72 75														
30		55 59	58 62	65 69	72 75															
8 0	55 59	62 66	70 73	77																
30	59 63	66 70	74 78																	
9 0	62 66	70 74	79																	
30	66 70	74 79																		
10 0	69 74	78																		
30	73 77																			
11 0	76 81																			
30	80																			

TABLE VIII. B. CONTRACTION OF ☉'S SEMIDIAMETER.

Whole Correction of ☉.	ARGUMENT = NUMBER FROM TABLE VIII. A.															
	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	78
0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
2 0			2	2	2	2	2	2	2	2	2	2	2	2	2	2
30					3	3	3	3	3	3	3	3	3	3	3	3
4 0							5	5	4	4	4	4	4	3	3	3
20							7	6	6	5	5	5	5	5	4	4
40								7	7	6	6	6	6	6	5	5
5 0								9	8	8	7	7	6	6	6	6
20								10	9	8	8	7	7	7	6	6
40									10	9	9	8	8	8	7	7
6 0									11	10	10	9	9	9	8	8
20									12	11	11	10	10	10	9	9
40										12	11	11	10	10	10	9
7 0										13	12	12	11	11	11	10
20										14	13	13	12	12	12	11
40										16	15	15	14	14	13	13
8 0											16	15	15	14	14	13
20											17	16	16	15	15	14
40											18	17	17	16	16	15
9 0												18	17	17	16	16
20												20	19	19	18	18
40												21	20	20	19	19
10 0													21	20	20	19
20													23	22	22	21
40													24	23	23	22
11 0														25	24	24
20															25	24
40																26
28																
27																
26																
25																
24																
23																
22																
21																
20																
19																
18																
17																
16																
15																
14																
13																
12																
11																
10																
9																
8																
7																
6																
5																
4																
3																
2																
1																
0																

Subtract this correction from the distance.

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
0 ^h 0 ^m 0 ^s	0.0000	0.3010	0.4771	0.6021	0.6990	0.7782	0.8451	0.9031	0.9542	
0 10	1.0000	1.0414	1.0792	1.1139	1.1461	1.1761	1.2041	1.2304	1.2553	1.2788
0 20	1.3010	1.3222	1.3424	1.3617	1.3802	1.3979	1.4150	1.4314	1.4472	1.4624
0 30	1.4771	1.4914	1.5051	1.5185	1.5315	1.5441	1.5563	1.5682	1.5798	1.5911
0 40	1.6021	1.6128	1.6232	1.6335	1.6435	1.6532	1.6628	1.6721	1.6812	1.6902
0 50	1.6990	1.7076	1.7160	1.7243	1.7324	1.7404	1.7482	1.7559	1.7634	1.7709
0 1 0	1.7782	1.7853	1.7924	1.7993	1.8062	1.8129	1.8195	1.8261	1.8325	1.8388
1 10	1.8451	1.8513	1.8573	1.8633	1.8692	1.8751	1.8808	1.8865	1.8921	1.8976
1 20	1.9031	1.9085	1.9138	1.9191	1.9243	1.9294	1.9345	1.9395	1.9445	1.9494
1 30	1.9542	1.9589	1.9638	1.9685	1.9731	1.9777	1.9823	1.9868	1.9912	1.9956
1 40	2.0000	2.0043	2.0086	2.0128	2.0170	2.0212	2.0253	2.0294	2.0334	2.0374
1 50	2.0414	2.0453	2.0492	2.0531	2.0569	2.0607	2.0645	2.0682	2.0719	2.0755
0 2 0	2.0792	2.0828	2.0864	2.0899	2.0934	2.0969	2.1004	2.1038	2.1072	2.1106
2 10	2.1139	2.1173	2.1206	2.1239	2.1271	2.1303	2.1335	2.1367	2.1399	2.1430
2 20	2.1461	2.1492	2.1523	2.1553	2.1584	2.1614	2.1644	2.1673	2.1703	2.1732
2 30	2.1761	2.1790	2.1818	2.1847	2.1875	2.1903	2.1931	2.1959	2.1987	2.2014
2 40	2.2041	2.2068	2.2095	2.2122	2.2148	2.2175	2.2201	2.2227	2.2253	2.2279
2 50	2.2304	2.2330	2.2355	2.2380	2.2405	2.2430	2.2455	2.2480	2.2504	2.2529
0 3 0	2.2553	2.2577	2.2601	2.2625	2.2648	2.2672	2.2695	2.2718	2.2742	2.2765
3 10	2.2788	2.2810	2.2833	2.2856	2.2878	2.2900	2.2923	2.2945	2.2967	2.2989
3 20	2.3010	2.3032	2.3054	2.3075	2.3096	2.3118	2.3139	2.3160	2.3181	2.3201
3 30	2.3222	2.3243	2.3263	2.3284	2.3304	2.3324	2.3345	2.3365	2.3385	2.3404
3 40	2.3424	2.3444	2.3464	2.3483	2.3502	2.3522	2.3541	2.3560	2.3579	2.3598
3 50	2.3617	2.3636	2.3655	2.3674	2.3692	2.3711	2.3729	2.3747	2.3766	2.3784
0 4 0	2.3802	2.3820	2.3838	2.3856	2.3874	2.3892	2.3909	2.3927	2.3945	2.3962
4 10	2.3979	2.3997	2.4014	2.4031	2.4048	2.4065	2.4082	2.4099	2.4116	2.4133
4 20	2.4150	2.4166	2.4183	2.4200	2.4216	2.4232	2.4249	2.4265	2.4281	2.4298
4 30	2.4314	2.4330	2.4346	2.4362	2.4378	2.4393	2.4409	2.4425	2.4440	2.4456
4 40	2.4472	2.4487	2.4502	2.4518	2.4533	2.4548	2.4564	2.4579	2.4594	2.4609
4 50	2.4624	2.4639	2.4654	2.4669	2.4683	2.4698	2.4713	2.4728	2.4742	2.4757
0 5 0	2.4771	2.4786	2.4800	2.4814	2.4829	2.4843	2.4857	2.4871	2.4886	2.4900
5 10	2.4914	2.4928	2.4942	2.4955	2.4969	2.4983	2.4997	2.5011	2.5024	2.5038
5 20	2.5051	2.5065	2.5079	2.5092	2.5105	2.5119	2.5132	2.5145	2.5159	2.5172
5 30	2.5185	2.5198	2.5211	2.5224	2.5237	2.5250	2.5263	2.5276	2.5289	2.5302
5 40	2.5315	2.5328	2.5340	2.5353	2.5366	2.5378	2.5391	2.5403	2.5416	2.5428
5 50	2.5441	2.5453	2.5465	2.5478	2.5490	2.5502	2.5514	2.5527	2.5539	2.5551
0 6 0	2.5563	2.5575	2.5587	2.5599	2.5611	2.5623	2.5635	2.5647	2.5658	2.5670
6 10	2.5682	2.5694	2.5705	2.5717	2.5729	2.5740	2.5752	2.5763	2.5775	2.5786
6 20	2.5798	2.5809	2.5821	2.5832	2.5843	2.5855	2.5866	2.5877	2.5888	2.5899
6 30	2.5911	2.5922	2.5933	2.5944	2.5955	2.5966	2.5977	2.5988	2.5999	2.6010
6 40	2.6021	2.6031	2.6042	2.6053	2.6064	2.6075	2.6085	2.6096	2.6107	2.6117
6 50	2.6128	2.6138	2.6149	2.6160	2.6170	2.6180	2.6191	2.6201	2.6212	2.6222
0 7 0	2.6232	2.6243	2.6253	2.6263	2.6274	2.6284	2.6294	2.6304	2.6314	2.6325
7 10	2.6335	2.6345	2.6355	2.6365	2.6375	2.6385	2.6395	2.6405	2.6415	2.6425
7 20	2.6435	2.6444	2.6454	2.6464	2.6474	2.6484	2.6493	2.6503	2.6513	2.6522
7 30	2.6532	2.6542	2.6551	2.6561	2.6571	2.6580	2.6590	2.6599	2.6609	2.6618
7 40	2.6628	2.6637	2.6646	2.6656	2.6665	2.6675	2.6684	2.6693	2.6702	2.6712
7 50	2.6721	2.6730	2.6739	2.6749	2.6758	2.6767	2.6776	2.6785	2.6794	2.6803
0 8 0	2.6812	2.6821	2.6830	2.6839	2.6848	2.6857	2.6866	2.6875	2.6884	2.6893
8 10	2.6902	2.6911	2.6920	2.6929	2.6937	2.6946	2.6955	2.6964	2.6972	2.6981
8 20	2.6990	2.6998	2.7007	2.7016	2.7024	2.7033	2.7042	2.7050	2.7059	2.7067
8 30	2.7076	2.7084	2.7093	2.7101	2.7110	2.7118	2.7126	2.7135	2.7143	2.7152
8 40	2.7160	2.7168	2.7177	2.7185	2.7193	2.7202	2.7210	2.7218	2.7226	2.7235
8 50	2.7243	2.7251	2.7259	2.7267	2.7275	2.7284	2.7292	2.7300	2.7308	2.7316
0 9 0	2.7324	2.7332	2.7340	2.7348	2.7356	2.7364	2.7372	2.7380	2.7388	2.7396
9 10	2.7404	2.7412	2.7419	2.7427	2.7435	2.7443	2.7451	2.7459	2.7466	2.7474
9 20	2.7482	2.7490	2.7497	2.7505	2.7513	2.7520	2.7528	2.7536	2.7543	2.7551
9 30	2.7559	2.7566	2.7574	2.7582	2.7589	2.7597	2.7604	2.7612	2.7619	2.7627
9 40	2.7634	2.7642	2.7649	2.7657	2.7664	2.7672	2.7679	2.7686	2.7694	2.7701
9 50	2.7709	2.7716	2.7723	2.7731	2.7738	2.7745	2.7752	2.7760	2.7767	2.7774

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
0° 10' 0"	2.7782	2.7789	2.7796	2.7803	2.7810	2.7818	2.7825	2.7832	2.7839	2.7846
10 10	2.7853	2.7860	2.7868	2.7875	2.7882	2.7889	2.7896	2.7903	2.7910	2.7917
10 20	2.7924	2.7931	2.7938	2.7945	2.7952	2.7959	2.7966	2.7973	2.7980	2.7987
10 30	2.7993	2.8000	2.8007	2.8014	2.8021	2.8028	2.8035	2.8041	2.8048	2.8055
10 40	2.8062	2.8069	2.8075	2.8082	2.8089	2.8096	2.8102	2.8109	2.8116	2.8122
10 50	2.8129	2.8136	2.8142	2.8149	2.8156	2.8162	2.8169	2.8176	2.8182	2.8189
0 11 0	2.8195	2.8202	2.8209	2.8215	2.8222	2.8228	2.8235	2.8241	2.8248	2.8254
11 10	2.8261	2.8267	2.8274	2.8280	2.8287	2.8293	2.8299	2.8306	2.8312	2.8319
11 20	2.8325	2.8331	2.8338	2.8344	2.8351	2.8357	2.8363	2.8370	2.8376	2.8382
11 30	2.8388	2.8395	2.8401	2.8407	2.8414	2.8420	2.8426	2.8432	2.8439	2.8445
11 40	2.8451	2.8457	2.8463	2.8470	2.8476	2.8482	2.8488	2.8494	2.8500	2.8506
11 50	2.8513	2.8519	2.8525	2.8531	2.8537	2.8543	2.8549	2.8555	2.8561	2.8567
0 12 0	2.8573	2.8579	2.8585	2.8591	2.8597	2.8603	2.8609	2.8615	2.8621	2.8627
12 10	2.8633	2.8639	2.8645	2.8651	2.8657	2.8663	2.8669	2.8675	2.8681	2.8686
12 20	2.8692	2.8698	2.8704	2.8710	2.8716	2.8722	2.8727	2.8733	2.8739	2.8745
12 30	2.8751	2.8756	2.8762	2.8768	2.8774	2.8779	2.8785	2.8791	2.8797	2.8802
12 40	2.8808	2.8814	2.8820	2.8825	2.8831	2.8837	2.8842	2.8848	2.8854	2.8859
12 50	2.8865	2.8871	2.8876	2.8882	2.8887	2.8893	2.8899	2.8904	2.8910	2.8915
0 13 0	2.8921	2.8927	2.8932	2.8938	2.8943	2.8949	2.8954	2.8960	2.8965	2.8971
13 10	2.8976	2.8982	2.8987	2.8993	2.8998	2.9004	2.9009	2.9015	2.9020	2.9025
13 20	2.9031	2.9036	2.9042	2.9047	2.9053	2.9058	2.9063	2.9069	2.9074	2.9079
13 30	2.9085	2.9090	2.9096	2.9101	2.9106	2.9112	2.9117	2.9122	2.9128	2.9133
13 40	2.9138	2.9143	2.9149	2.9154	2.9159	2.9165	2.9170	2.9175	2.9180	2.9186
13 50	2.9191	2.9196	2.9201	2.9206	2.9212	2.9217	2.9222	2.9227	2.9232	2.9238
0 14 0	2.9243	2.9248	2.9253	2.9258	2.9263	2.9269	2.9274	2.9279	2.9284	2.9289
14 10	2.9294	2.9299	2.9304	2.9309	2.9315	2.9320	2.9325	2.9330	2.9335	2.9340
14 20	2.9345	2.9350	2.9355	2.9360	2.9365	2.9370	2.9375	2.9380	2.9385	2.9390
14 30	2.9395	2.9400	2.9405	2.9410	2.9415	2.9420	2.9425	2.9430	2.9435	2.9440
14 40	2.9445	2.9450	2.9455	2.9460	2.9465	2.9469	2.9474	2.9479	2.9484	2.9489
14 50	2.9494	2.9499	2.9504	2.9509	2.9513	2.9518	2.9523	2.9528	2.9533	2.9538
0 15 0	2.9542	2.9547	2.9552	2.9557	2.9562	2.9566	2.9571	2.9576	2.9581	2.9586
15 10	2.9590	2.9595	2.9600	2.9605	2.9609	2.9614	2.9619	2.9624	2.9628	2.9633
15 20	2.9638	2.9643	2.9647	2.9652	2.9657	2.9661	2.9666	2.9671	2.9675	2.9680
15 30	2.9685	2.9689	2.9694	2.9699	2.9703	2.9708	2.9713	2.9717	2.9722	2.9727
15 40	2.9731	2.9736	2.9741	2.9745	2.9750	2.9754	2.9759	2.9763	2.9768	2.9773
15 50	2.9777	2.9782	2.9786	2.9791	2.9795	2.9800	2.9805	2.9809	2.9814	2.9818
0 16 0	2.9823	2.9827	2.9832	2.9836	2.9841	2.9845	2.9850	2.9854	2.9859	2.9863
16 10	2.9868	2.9872	2.9877	2.9881	2.9886	2.9890	2.9894	2.9899	2.9903	2.9908
16 20	2.9912	2.9917	2.9921	2.9926	2.9930	2.9934	2.9939	2.9943	2.9948	2.9952
16 30	2.9956	2.9961	2.9965	2.9969	2.9974	2.9978	2.9983	2.9987	2.9991	2.9996
16 40	3.0000	3.0004	3.0009	3.0013	3.0017	3.0022	3.0026	3.0030	3.0035	3.0039
16 50	3.0043	3.0048	3.0052	3.0056	3.0060	3.0065	3.0069	3.0073	3.0077	3.0082
0 17 0	3.0086	3.0090	3.0095	3.0099	3.0103	3.0107	3.0111	3.0116	3.0120	3.0124
17 10	3.0128	3.0133	3.0137	3.0141	3.0145	3.0149	3.0154	3.0158	3.0162	3.0166
17 20	3.0170	3.0175	3.0179	3.0183	3.0187	3.0191	3.0195	3.0199	3.0204	3.0208
17 30	3.0212	3.0216	3.0220	3.0224	3.0228	3.0233	3.0237	3.0241	3.0245	3.0249
17 40	3.0253	3.0257	3.0261	3.0265	3.0269	3.0273	3.0278	3.0282	3.0286	3.0290
17 50	3.0294	3.0298	3.0302	3.0306	3.0310	3.0314	3.0318	3.0322	3.0326	3.0330
0 18 0	3.0334	3.0338	3.0342	3.0346	3.0350	3.0354	3.0358	3.0362	3.0366	3.0370
18 10	3.0374	3.0378	3.0382	3.0386	3.0390	3.0394	3.0398	3.0402	3.0406	3.0410
18 20	3.0414	3.0418	3.0422	3.0426	3.0430	3.0434	3.0438	3.0441	3.0445	3.0449
18 30	3.0453	3.0457	3.0461	3.0465	3.0469	3.0473	3.0477	3.0481	3.0484	3.0488
18 40	3.0492	3.0496	3.0500	3.0504	3.0508	3.0512	3.0515	3.0519	3.0523	3.0527
18 50	3.0531	3.0535	3.0538	3.0542	3.0546	3.0550	3.0554	3.0558	3.0561	3.0565
0 19 0	3.0569	3.0573	3.0577	3.0580	3.0584	3.0588	3.0592	3.0596	3.0599	3.0603
19 10	3.0607	3.0611	3.0615	3.0618	3.0622	3.0626	3.0630	3.0633	3.0637	3.0641
19 20	3.0645	3.0648	3.0652	3.0656	3.0660	3.0663	3.0667	3.0671	3.0674	3.0678
19 30	3.0682	3.0686	3.0689	3.0693	3.0697	3.0700	3.0704	3.0708	3.0711	3.0715
19 40	3.0719	3.0722	3.0726	3.0730	3.0734	3.0737	3.0741	3.0745	3.0748	3.0752
19 50	3.0755	3.0759	3.0763	3.0766	3.0770	3.0774	3.0777	3.0781	3.0785	3.0788

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
0 ^h 20 ^m 0 ^s	3.0792	3.0795	3.0799	3.0803	3.0806	3.0810	3.0813	3.0817	3.0821	3.0824
20 10	3.0828	3.0831	3.0835	3.0839	3.0842	3.0846	3.0849	3.0853	3.0856	3.0860
20 20	3.0864	3.0867	3.0871	3.0874	3.0878	3.0881	3.0885	3.0888	3.0892	3.0896
20 30	3.0899	3.0903	3.0906	3.0910	3.0913	3.0917	3.0920	3.0924	3.0927	3.0931
20 40	3.0934	3.0938	3.0941	3.0945	3.0948	3.0952	3.0955	3.0959	3.0962	3.0966
20 50	3.0969	3.0973	3.0976	3.0980	3.0983	3.0986	3.0990	3.0993	3.0997	3.1000
0 21 0	3.1004	3.1007	3.1011	3.1014	3.1017	3.1021	3.1024	3.1028	3.1031	3.1035
21 10	3.1038	3.1041	3.1045	3.1048	3.1052	3.1055	3.1059	3.1062	3.1065	3.1069
21 20	3.1072	3.1075	3.1079	3.1082	3.1086	3.1089	3.1092	3.1096	3.1099	3.1103
21 30	3.1106	3.1109	3.1113	3.1116	3.1119	3.1123	3.1126	3.1129	3.1133	3.1136
21 40	3.1139	3.1143	3.1146	3.1149	3.1153	3.1156	3.1159	3.1163	3.1166	3.1169
21 50	3.1173	3.1176	3.1179	3.1183	3.1186	3.1189	3.1193	3.1196	3.1199	3.1202
0 22 0	3.1206	3.1209	3.1212	3.1216	3.1219	3.1222	3.1225	3.1229	3.1232	3.1235
22 10	3.1239	3.1242	3.1245	3.1248	3.1252	3.1255	3.1258	3.1261	3.1265	3.1268
22 20	3.1271	3.1274	3.1278	3.1281	3.1284	3.1287	3.1290	3.1294	3.1297	3.1300
22 30	3.1303	3.1307	3.1310	3.1313	3.1316	3.1319	3.1323	3.1326	3.1329	3.1332
22 40	3.1335	3.1339	3.1342	3.1345	3.1348	3.1351	3.1355	3.1358	3.1361	3.1364
22 50	3.1367	3.1370	3.1374	3.1377	3.1380	3.1383	3.1386	3.1389	3.1392	3.1396
0 23 0	3.1399	3.1402	3.1405	3.1408	3.1411	3.1414	3.1418	3.1421	3.1424	3.1427
23 10	3.1430	3.1433	3.1436	3.1440	3.1443	3.1446	3.1449	3.1452	3.1455	3.1458
23 20	3.1461	3.1464	3.1467	3.1471	3.1474	3.1477	3.1480	3.1483	3.1486	3.1489
23 30	3.1492	3.1495	3.1498	3.1501	3.1504	3.1508	3.1511	3.1514	3.1517	3.1520
23 40	3.1523	3.1526	3.1529	3.1532	3.1535	3.1538	3.1541	3.1544	3.1547	3.1550
23 50	3.1553	3.1556	3.1559	3.1562	3.1565	3.1569	3.1572	3.1575	3.1578	3.1581
0 24 0	3.1584	3.1587	3.1590	3.1593	3.1596	3.1599	3.1602	3.1605	3.1608	3.1611
24 10	3.1614	3.1617	3.1620	3.1623	3.1626	3.1629	3.1632	3.1635	3.1638	3.1641
24 20	3.1644	3.1647	3.1649	3.1652	3.1655	3.1658	3.1661	3.1664	3.1667	3.1670
24 30	3.1673	3.1676	3.1679	3.1682	3.1685	3.1688	3.1691	3.1694	3.1697	3.1700
24 40	3.1703	3.1706	3.1708	3.1711	3.1714	3.1717	3.1720	3.1723	3.1726	3.1729
24 50	3.1732	3.1735	3.1738	3.1741	3.1744	3.1746	3.1749	3.1752	3.1755	3.1758
0 25 0	3.1761	3.1764	3.1767	3.1770	3.1772	3.1775	3.1778	3.1781	3.1784	3.1787
25 10	3.1790	3.1793	3.1796	3.1798	3.1801	3.1804	3.1807	3.1810	3.1813	3.1816
25 20	3.1818	3.1821	3.1824	3.1827	3.1830	3.1833	3.1836	3.1838	3.1841	3.1844
25 30	3.1847	3.1850	3.1853	3.1855	3.1858	3.1861	3.1864	3.1867	3.1870	3.1872
25 40	3.1875	3.1878	3.1881	3.1884	3.1886	3.1889	3.1892	3.1895	3.1898	3.1901
25 50	3.1903	3.1906	3.1909	3.1912	3.1915	3.1917	3.1920	3.1923	3.1926	3.1928
0 26 0	3.1931	3.1934	3.1937	3.1940	3.1942	3.1945	3.1948	3.1951	3.1953	3.1956
26 10	3.1959	3.1962	3.1965	3.1967	3.1970	3.1973	3.1976	3.1978	3.1981	3.1984
26 20	3.1987	3.1989	3.1992	3.1995	3.1998	3.2000	3.2003	3.2006	3.2009	3.2011
26 30	3.2014	3.2017	3.2019	3.2022	3.2025	3.2028	3.2030	3.2033	3.2036	3.2038
26 40	3.2041	3.2044	3.2047	3.2049	3.2052	3.2055	3.2057	3.2060	3.2063	3.2066
26 50	3.2068	3.2071	3.2074	3.2076	3.2079	3.2082	3.2084	3.2087	3.2090	3.2092
0 27 0	3.2095	3.2098	3.2101	3.2103	3.2106	3.2109	3.2111	3.2114	3.2117	3.2119
27 10	3.2122	3.2125	3.2127	3.2130	3.2133	3.2135	3.2138	3.2140	3.2143	3.2146
27 20	3.2148	3.2151	3.2154	3.2156	3.2159	3.2162	3.2164	3.2167	3.2170	3.2172
27 30	3.2175	3.2177	3.2180	3.2183	3.2185	3.2188	3.2191	3.2193	3.2196	3.2198
27 40	3.2201	3.2204	3.2206	3.2209	3.2212	3.2214	3.2217	3.2219	3.2222	3.2225
27 50	3.2227	3.2230	3.2232	3.2235	3.2238	3.2240	3.2243	3.2245	3.2248	3.2250
0 28 0	3.2253	3.2256	3.2258	3.2261	3.2263	3.2266	3.2269	3.2271	3.2274	3.2276
28 10	3.2279	3.2281	3.2284	3.2287	3.2289	3.2292	3.2294	3.2297	3.2299	3.2302
28 20	3.2304	3.2307	3.2310	3.2312	3.2315	3.2317	3.2320	3.2322	3.2325	3.2327
28 30	3.2330	3.2333	3.2335	3.2338	3.2340	3.2343	3.2345	3.2348	3.2350	3.2353
28 40	3.2355	3.2358	3.2360	3.2363	3.2365	3.2368	3.2370	3.2373	3.2375	3.2378
28 50	3.2380	3.2383	3.2385	3.2388	3.2390	3.2393	3.2395	3.2398	3.2400	3.2403
0 29 0	3.2405	3.2408	3.2410	3.2413	3.2415	3.2418	3.2420	3.2423	3.2425	3.2428
29 10	3.2430	3.2433	3.2435	3.2438	3.2440	3.2443	3.2445	3.2448	3.2450	3.2453
29 20	3.2455	3.2458	3.2460	3.2463	3.2465	3.2467	3.2470	3.2472	3.2475	3.2477
29 30	3.2480	3.2482	3.2485	3.2487	3.2490	3.2492	3.2494	3.2497	3.2499	3.2502
29 40	3.2504	3.2507	3.2509	3.2512	3.2514	3.2516	3.2519	3.2521	3.2524	3.2526
29 50	3.2529	3.2531	3.2533	3.2536	3.2538	3.2541	3.2543	3.2545	3.2548	3.2550

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
0 ^h . 30 ^m . 0 ^s .	3.2553	3.2555	3.2558	3.2560	3.2562	3.2565	3.2567	3.2570	3.2572	3.2574
30 10	3.2577	3.2579	3.2582	3.2584	3.2586	3.2589	3.2591	3.2594	3.2596	3.2598
30 20	3.2601	3.2603	3.2605	3.2608	3.2610	3.2613	3.2615	3.2617	3.2620	3.2622
30 30	3.2625	3.2627	3.2629	3.2632	3.2634	3.2636	3.2639	3.2641	3.2643	3.2646
30 40	3.2648	3.2651	3.2653	3.2655	3.2658	3.2660	3.2662	3.2665	3.2667	3.2669
30 50	3.2672	3.2674	3.2676	3.2679	3.2681	3.2683	3.2686	3.2688	3.2690	3.2693
0 31 0	3.2695	3.2697	3.2700	3.2702	3.2704	3.2707	3.2709	3.2711	3.2714	3.2716
31 10	3.2718	3.2721	3.2723	3.2725	3.2728	3.2730	3.2732	3.2735	3.2737	3.2739
31 20	3.2742	3.2744	3.2746	3.2749	3.2751	3.2753	3.2755	3.2758	3.2760	3.2762
31 30	3.2765	3.2767	3.2769	3.2772	3.2774	3.2776	3.2778	3.2781	3.2783	3.2785
31 40	3.2788	3.2790	3.2792	3.2794	3.2797	3.2799	3.2801	3.2804	3.2806	3.2808
31 50	3.2810	3.2813	3.2815	3.2817	3.2819	3.2822	3.2824	3.2826	3.2828	3.2831
0 32 0	3.2833	3.2835	3.2838	3.2840	3.2842	3.2844	3.2847	3.2849	3.2851	3.2853
32 10	3.2856	3.2858	3.2860	3.2862	3.2865	3.2867	3.2869	3.2871	3.2874	3.2876
32 20	3.2878	3.2880	3.2882	3.2885	3.2887	3.2889	3.2891	3.2894	3.2896	3.2898
32 30	3.2900	3.2903	3.2905	3.2907	3.2909	3.2911	3.2914	3.2916	3.2918	3.2920
32 40	3.2923	3.2925	3.2927	3.2929	3.2931	3.2934	3.2936	3.2938	3.2940	3.2942
32 50	3.2945	3.2947	3.2949	3.2951	3.2953	3.2956	3.2958	3.2960	3.2962	3.2964
0 33 0	3.2967	3.2969	3.2971	3.2973	3.2975	3.2978	3.2980	3.2982	3.2984	3.2986
33 10	3.2989	3.2991	3.2993	3.2995	3.2997	3.2999	3.3002	3.3004	3.3006	3.3008
33 20	3.3010	3.3012	3.3015	3.3017	3.3019	3.3021	3.3023	3.3025	3.3028	3.3030
33 30	3.3032	3.3034	3.3036	3.3038	3.3041	3.3043	3.3045	3.3047	3.3049	3.3051
33 40	3.3054	3.3056	3.3058	3.3060	3.3062	3.3064	3.3066	3.3069	3.3071	3.3073
33 50	3.3075	3.3077	3.3079	3.3081	3.3084	3.3086	3.3088	3.3090	3.3092	3.3094
0 34 0	3.3096	3.3098	3.3101	3.3103	3.3105	3.3107	3.3109	3.3111	3.3113	3.3115
34 10	3.3118	3.3120	3.3122	3.3124	3.3126	3.3128	3.3130	3.3132	3.3134	3.3137
34 20	3.3139	3.3141	3.3143	3.3145	3.3147	3.3149	3.3151	3.3153	3.3156	3.3158
34 30	3.3160	3.3162	3.3164	3.3166	3.3168	3.3170	3.3172	3.3174	3.3176	3.3179
34 40	3.3181	3.3183	3.3185	3.3187	3.3189	3.3191	3.3193	3.3195	3.3197	3.3199
34 50	3.3201	3.3204	3.3206	3.3208	3.3210	3.3212	3.3214	3.3216	3.3218	3.3220
0 35 0	3.3222	3.3224	3.3226	3.3228	3.3230	3.3233	3.3235	3.3237	3.3239	3.3241
35 10	3.3243	3.3245	3.3247	3.3249	3.3251	3.3253	3.3255	3.3257	3.3259	3.3261
35 20	3.3263	3.3265	3.3267	3.3269	3.3272	3.3274	3.3276	3.3278	3.3280	3.3282
35 30	3.3284	3.3286	3.3288	3.3290	3.3292	3.3294	3.3296	3.3298	3.3300	3.3302
35 40	3.3304	3.3306	3.3308	3.3310	3.3312	3.3314	3.3316	3.3318	3.3320	3.3322
35 50	3.3324	3.3326	3.3328	3.3330	3.3332	3.3334	3.3336	3.3339	3.3341	3.3343
0 36 0	3.3345	3.3347	3.3349	3.3351	3.3353	3.3355	3.3357	3.3359	3.3361	3.3363
36 10	3.3365	3.3367	3.3369	3.3371	3.3373	3.3375	3.3377	3.3379	3.3381	3.3383
36 20	3.3385	3.3387	3.3389	3.3391	3.3393	3.3395	3.3397	3.3398	3.3400	3.3402
36 30	3.3404	3.3406	3.3408	3.3410	3.3412	3.3414	3.3416	3.3418	3.3420	3.3422
36 40	3.3424	3.3426	3.3428	3.3430	3.3432	3.3434	3.3436	3.3438	3.3440	3.3442
36 50	3.3444	3.3446	3.3448	3.3450	3.3452	3.3454	3.3456	3.3458	3.3460	3.3462
0 37 0	3.3464	3.3465	3.3467	3.3469	3.3471	3.3473	3.3475	3.3477	3.3479	3.3481
37 10	3.3483	3.3485	3.3487	3.3489	3.3491	3.3493	3.3495	3.3497	3.3499	3.3501
37 20	3.3502	3.3504	3.3506	3.3508	3.3510	3.3512	3.3514	3.3516	3.3518	3.3520
37 30	3.3522	3.3524	3.3526	3.3528	3.3530	3.3531	3.3533	3.3535	3.3537	3.3539
37 40	3.3541	3.3543	3.3545	3.3547	3.3549	3.3551	3.3553	3.3555	3.3556	3.3558
37 50	3.3560	3.3562	3.3564	3.3566	3.3568	3.3570	3.3572	3.3574	3.3576	3.3577
0 38 0	3.3579	3.3581	3.3583	3.3585	3.3587	3.3589	3.3591	3.3593	3.3595	3.3596
38 10	3.3598	3.3600	3.3602	3.3604	3.3606	3.3608	3.3610	3.3612	3.3614	3.3615
38 20	3.3617	3.3619	3.3621	3.3623	3.3625	3.3627	3.3629	3.3630	3.3632	3.3634
38 30	3.3636	3.3638	3.3640	3.3642	3.3644	3.3646	3.3647	3.3649	3.3651	3.3653
38 40	3.3655	3.3657	3.3659	3.3660	3.3662	3.3664	3.3666	3.3668	3.3670	3.3672
38 50	3.3674	3.3675	3.3677	3.3679	3.3681	3.3683	3.3685	3.3687	3.3688	3.3690
0 39 0	3.3692	3.3694	3.3696	3.3698	3.3700	3.3701	3.3703	3.3705	3.3707	3.3709
39 10	3.3711	3.3713	3.3714	3.3716	3.3718	3.3720	3.3722	3.3724	3.3725	3.3727
39 20	3.3729	3.3731	3.3733	3.3735	3.3736	3.3738	3.3740	3.3742	3.3744	3.3746
39 30	3.3747	3.3749	3.3751	3.3753	3.3755	3.3757	3.3758	3.3760	3.3762	3.3764
39 40	3.3766	3.3768	3.3769	3.3771	3.3773	3.3775	3.3777	3.3779	3.3780	3.3782
39 50	3.3784	3.3786	3.3788	3.3789	3.3791	3.3793	3.3795	3.3797	3.3798	3.3800

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
0° 10' 0"	3.3802	3.3804	3.3806	3.3808	3.3809	3.3811	3.3813	3.3815	3.3817	3.3818
40 10	3.3820	3.3822	3.3824	3.3826	3.3827	3.3829	3.3831	3.3833	3.3835	3.3836
40 20	3.3838	3.3840	3.3842	3.3844	3.3845	3.3847	3.3849	3.3851	3.3852	3.3854
40 30	3.3856	3.3858	3.3860	3.3861	3.3863	3.3865	3.3867	3.3869	3.3870	3.3872
40 40	3.3874	3.3876	3.3877	3.3879	3.3881	3.3883	3.3885	3.3886	3.3888	3.3890
40 50	3.3892	3.3893	3.3895	3.3897	3.3899	3.3901	3.3902	3.3904	3.3906	3.3908
41 0	3.3909	3.3911	3.3913	3.3915	3.3916	3.3918	3.3920	3.3922	3.3923	3.3925
41 10	3.3927	3.3929	3.3930	3.3932	3.3934	3.3936	3.3938	3.3939	3.3941	3.3943
41 20	3.3945	3.3946	3.3948	3.3950	3.3952	3.3953	3.3955	3.3957	3.3959	3.3960
41 30	3.3962	3.3964	3.3965	3.3967	3.3969	3.3971	3.3972	3.3974	3.3976	3.3978
41 40	3.3979	3.3981	3.3983	3.3985	3.3986	3.3988	3.3990	3.3992	3.3993	3.3995
41 50	3.3997	3.3998	3.4000	3.4002	3.4004	3.4005	3.4007	3.4009	3.4011	3.4012
0 42 0	3.4014	3.4016	3.4017	3.4019	3.4021	3.4023	3.4024	3.4026	3.4028	3.4029
42 10	3.4031	3.4033	3.4035	3.4036	3.4038	3.4040	3.4041	3.4043	3.4045	3.4047
42 20	3.4048	3.4050	3.4052	3.4053	3.4055	3.4057	3.4059	3.4060	3.4062	3.4064
42 30	3.4065	3.4067	3.4069	3.4071	3.4072	3.4074	3.4076	3.4077	3.4079	3.4081
42 40	3.4082	3.4084	3.4086	3.4087	3.4089	3.4091	3.4093	3.4094	3.4096	3.4098
42 50	3.4099	3.4101	3.4103	3.4104	3.4106	3.4108	3.4109	3.4111	3.4113	3.4115
0 43 0	3.4116	3.4118	3.4120	3.4121	3.4123	3.4125	3.4126	3.4128	3.4130	3.4131
43 10	3.4133	3.4135	3.4136	3.4138	3.4140	3.4141	3.4143	3.4145	3.4146	3.4148
43 20	3.4150	3.4151	3.4153	3.4155	3.4156	3.4158	3.4160	3.4161	3.4163	3.4165
43 30	3.4166	3.4168	3.4170	3.4171	3.4173	3.4175	3.4176	3.4178	3.4180	3.4181
43 40	3.4183	3.4185	3.4186	3.4188	3.4190	3.4191	3.4193	3.4195	3.4196	3.4198
43 50	3.4200	3.4201	3.4203	3.4205	3.4206	3.4208	3.4209	3.4211	3.4213	3.4214
0 44 0	3.4216	3.4218	3.4219	3.4221	3.4223	3.4224	3.4226	3.4228	3.4229	3.4231
44 10	3.4232	3.4234	3.4236	3.4237	3.4239	3.4241	3.4242	3.4244	3.4246	3.4247
44 20	3.4249	3.4250	3.4252	3.4254	3.4255	3.4257	3.4259	3.4260	3.4262	3.4263
44 30	3.4265	3.4267	3.4268	3.4270	3.4272	3.4273	3.4275	3.4276	3.4278	3.4280
44 40	3.4281	3.4283	3.4285	3.4286	3.4288	3.4289	3.4291	3.4293	3.4294	3.4296
44 50	3.4298	3.4299	3.4301	3.4302	3.4304	3.4306	3.4307	3.4309	3.4310	3.4312
0 45 0	3.4314	3.4315	3.4317	3.4318	3.4320	3.4322	3.4323	3.4325	3.4326	3.4328
45 10	3.4330	3.4331	3.4333	3.4334	3.4336	3.4338	3.4339	3.4341	3.4342	3.4344
45 20	3.4346	3.4347	3.4349	3.4350	3.4352	3.4354	3.4355	3.4357	3.4358	3.4360
45 30	3.4362	3.4363	3.4365	3.4366	3.4368	3.4370	3.4371	3.4373	3.4374	3.4376
45 40	3.4378	3.4379	3.4381	3.4382	3.4384	3.4385	3.4387	3.4389	3.4390	3.4392
45 50	3.4393	3.4395	3.4396	3.4398	3.4400	3.4401	3.4403	3.4404	3.4406	3.4408
0 46 0	3.4409	3.4411	3.4412	3.4414	3.4415	3.4417	3.4419	3.4420	3.4422	3.4423
46 10	3.4425	3.4426	3.4428	3.4429	3.4431	3.4433	3.4434	3.4436	3.4437	3.4439
46 20	3.4440	3.4442	3.4444	3.4445	3.4447	3.4448	3.4450	3.4451	3.4453	3.4454
46 30	3.4456	3.4458	3.4459	3.4461	3.4462	3.4464	3.4465	3.4467	3.4468	3.4470
46 40	3.4472	3.4473	3.4475	3.4476	3.4478	3.4479	3.4481	3.4482	3.4484	3.4486
46 50	3.4487	3.4489	3.4490	3.4492	3.4493	3.4495	3.4496	3.4498	3.4499	3.4501
0 47 0	3.4502	3.4504	3.4506	3.4507	3.4509	3.4510	3.4512	3.4513	3.4515	3.4516
47 10	3.4518	3.4519	3.4521	3.4522	3.4524	3.4526	3.4527	3.4529	3.4530	3.4532
47 20	3.4533	3.4535	3.4536	3.4538	3.4539	3.4541	3.4542	3.4544	3.4545	3.4547
47 30	3.4548	3.4550	3.4551	3.4553	3.4555	3.4556	3.4558	3.4559	3.4561	3.4562
47 40	3.4564	3.4565	3.4567	3.4568	3.4570	3.4571	3.4573	3.4574	3.4576	3.4577
47 50	3.4579	3.4580	3.4582	3.4583	3.4585	3.4586	3.4588	3.4589	3.4591	3.4592
0 48 0	3.4594	3.4595	3.4597	3.4598	3.4600	3.4601	3.4603	3.4604	3.4606	3.4607
48 10	3.4609	3.4610	3.4612	3.4613	3.4615	3.4616	3.4618	3.4619	3.4621	3.4622
48 20	3.4624	3.4625	3.4627	3.4628	3.4630	3.4631	3.4633	3.4634	3.4636	3.4637
48 30	3.4639	3.4640	3.4642	3.4643	3.4645	3.4646	3.4648	3.4649	3.4651	3.4652
48 40	3.4654	3.4655	3.4657	3.4658	3.4660	3.4661	3.4663	3.4664	3.4666	3.4667
48 50	3.4669	3.4670	3.4672	3.4673	3.4675	3.4676	3.4678	3.4679	3.4681	3.4682
0 49 0	3.4683	3.4685	3.4686	3.4688	3.4689	3.4691	3.4692	3.4694	3.4695	3.4697
49 10	3.4698	3.4700	3.4701	3.4703	3.4704	3.4706	3.4707	3.4709	3.4710	3.4711
49 20	3.4713	3.4714	3.4716	3.4717	3.4719	3.4720	3.4722	3.4723	3.4725	3.4726
49 30	3.4728	3.4729	3.4730	3.4732	3.4733	3.4735	3.4736	3.4738	3.4739	3.4741
49 40	3.4742	3.4744	3.4745	3.4747	3.4748	3.4749	3.4751	3.4752	3.4754	3.4755
49 50	3.4757	3.4758	3.4760	3.4761	3.4763	3.4764	3.4765	3.4767	3.4768	3.4770

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
0 ^h .50 ^m .0 ^s .	3.4771	3.4773	3.4774	3.4776	3.4777	3.4778	3.4780	3.4781	3.4783	3.4784
50 10	3.4786	3.4787	3.4789	3.4790	3.4791	3.4793	3.4794	3.4796	3.4797	3.4799
50 20	3.4800	3.4802	3.4803	3.4804	3.4806	3.4807	3.4809	3.4810	3.4812	3.4813
50 30	3.4814	3.4816	3.4817	3.4819	3.4820	3.4822	3.4823	3.4824	3.4826	3.4827
50 40	3.4829	3.4830	3.4832	3.4833	3.4834	3.4836	3.4837	3.4839	3.4840	3.4842
50 50	3.4843	3.4844	3.4846	3.4847	3.4849	3.4850	3.4852	3.4853	3.4854	3.4856
0 51 0	3.4857	3.4859	3.4860	3.4861	3.4863	3.4864	3.4866	3.4867	3.4869	3.4870
51 10	3.4871	3.4873	3.4874	3.4876	3.4877	3.4878	3.4880	3.4881	3.4883	3.4884
51 20	3.4886	3.4887	3.4888	3.4890	3.4891	3.4893	3.4894	3.4895	3.4897	3.4898
51 30	3.4900	3.4901	3.4902	3.4904	3.4905	3.4907	3.4908	3.4909	3.4911	3.4912
51 40	3.4914	3.4915	3.4916	3.4918	3.4919	3.4921	3.4922	3.4923	3.4925	3.4926
51 50	3.4928	3.4929	3.4930	3.4932	3.4933	3.4935	3.4936	3.4937	3.4939	3.4940
0 52 0	3.4942	3.4943	3.4944	3.4946	3.4947	3.4949	3.4950	3.4951	3.4953	3.4954
52 10	3.4955	3.4957	3.4958	3.4960	3.4961	3.4962	3.4964	3.4965	3.4967	3.4968
52 20	3.4969	3.4971	3.4972	3.4973	3.4975	3.4976	3.4978	3.4979	3.4980	3.4982
52 30	3.4983	3.4984	3.4986	3.4987	3.4989	3.4990	3.4991	3.4993	3.4994	3.4995
52 40	3.4997	3.4998	3.5000	3.5001	3.5002	3.5004	3.5005	3.5006	3.5008	3.5009
52 50	3.5011	3.5012	3.5013	3.5015	3.5016	3.5017	3.5019	3.5020	3.5022	3.5023
0 53 0	3.5024	3.5026	3.5027	3.5028	3.5030	3.5031	3.5032	3.5034	3.5035	3.5037
53 10	3.5038	3.5039	3.5041	3.5042	3.5043	3.5045	3.5046	3.5047	3.5049	3.5050
53 20	3.5051	3.5053	3.5054	3.5056	3.5057	3.5058	3.5060	3.5061	3.5062	3.5064
53 30	3.5065	3.5066	3.5068	3.5069	3.5070	3.5072	3.5073	3.5075	3.5076	3.5077
53 40	3.5079	3.5080	3.5081	3.5083	3.5084	3.5085	3.5087	3.5088	3.5089	3.5091
53 50	3.5092	3.5093	3.5095	3.5096	3.5097	3.5099	3.5100	3.5101	3.5103	3.5104
0 54 0	3.5105	3.5107	3.5108	3.5109	3.5111	3.5112	3.5113	3.5115	3.5116	3.5117
54 10	3.5119	3.5120	3.5122	3.5123	3.5124	3.5126	3.5127	3.5128	3.5130	3.5131
54 20	3.5132	3.5134	3.5135	3.5136	3.5138	3.5139	3.5140	3.5141	3.5143	3.5144
54 30	3.5145	3.5147	3.5148	3.5149	3.5151	3.5152	3.5153	3.5155	3.5156	3.5157
54 40	3.5159	3.5160	3.5161	3.5163	3.5164	3.5165	3.5167	3.5168	3.5169	3.5171
54 50	3.5172	3.5173	3.5175	3.5176	3.5177	3.5179	3.5180	3.5181	3.5183	3.5184
0 55 0	3.5185	3.5186	3.5188	3.5189	3.5190	3.5192	3.5193	3.5194	3.5196	3.5197
55 10	3.5198	3.5200	3.5201	3.5202	3.5204	3.5205	3.5206	3.5207	3.5209	3.5210
55 20	3.5211	3.5213	3.5214	3.5215	3.5217	3.5218	3.5219	3.5221	3.5222	3.5223
55 30	3.5224	3.5226	3.5227	3.5228	3.5230	3.5231	3.5232	3.5234	3.5235	3.5236
55 40	3.5237	3.5239	3.5240	3.5241	3.5243	3.5244	3.5245	3.5247	3.5248	3.5249
55 50	3.5250	3.5252	3.5253	3.5254	3.5256	3.5257	3.5258	3.5260	3.5261	3.5262
0 56 0	3.5263	3.5265	3.5266	3.5267	3.5269	3.5270	3.5271	3.5272	3.5274	3.5275
56 10	3.5276	3.5278	3.5279	3.5280	3.5281	3.5283	3.5284	3.5285	3.5287	3.5288
56 20	3.5289	3.5290	3.5292	3.5293	3.5294	3.5296	3.5297	3.5298	3.5299	3.5301
56 30	3.5302	3.5303	3.5305	3.5306	3.5307	3.5308	3.5310	3.5311	3.5312	3.5314
56 40	3.5315	3.5316	3.5317	3.5319	3.5320	3.5321	3.5322	3.5324	3.5325	3.5326
56 50	3.5328	3.5329	3.5330	3.5331	3.5333	3.5334	3.5335	3.5336	3.5338	3.5339
0 57 0	3.5340	3.5342	3.5343	3.5344	3.5345	3.5347	3.5348	3.5349	3.5350	3.5352
57 10	3.5353	3.5354	3.5355	3.5357	3.5358	3.5359	3.5361	3.5362	3.5363	3.5364
57 20	3.5366	3.5367	3.5368	3.5369	3.5371	3.5372	3.5373	3.5374	3.5376	3.5377
57 30	3.5378	3.5379	3.5381	3.5382	3.5383	3.5384	3.5386	3.5387	3.5388	3.5390
57 40	3.5391	3.5392	3.5393	3.5395	3.5396	3.5397	3.5398	3.5400	3.5401	3.5402
57 50	3.5403	3.5405	3.5406	3.5407	3.5408	3.5410	3.5411	3.5412	3.5413	3.5415
0 58 0	3.5416	3.5417	3.5418	3.5420	3.5421	3.5422	3.5423	3.5425	3.5426	3.5427
58 10	3.5428	3.5429	3.5431	3.5432	3.5433	3.5434	3.5436	3.5437	3.5438	3.5439
58 20	3.5441	3.5442	3.5443	3.5444	3.5446	3.5447	3.5448	3.5449	3.5451	3.5452
58 30	3.5453	3.5454	3.5456	3.5457	3.5458	3.5459	3.5460	3.5462	3.5463	3.5464
58 40	3.5465	3.5467	3.5468	3.5469	3.5470	3.5472	3.5473	3.5474	3.5475	3.5477
58 50	3.5478	3.5479	3.5480	3.5481	3.5483	3.5484	3.5485	3.5486	3.5488	3.5489
0 59 0	3.5490	3.5491	3.5492	3.5494	3.5495	3.5496	3.5497	3.5499	3.5500	3.5501
59 10	3.5502	3.5504	3.5505	3.5506	3.5507	3.5508	3.5510	3.5511	3.5512	3.5513
59 20	3.5514	3.5516	3.5517	3.5518	3.5519	3.5521	3.5522	3.5523	3.5524	3.5525
59 30	3.5527	3.5528	3.5529	3.5530	3.5532	3.5533	3.5534	3.5535	3.5536	3.5538
59 40	3.5539	3.5540	3.5541	3.5542	3.5544	3.5545	3.5546	3.5547	3.5549	3.5550
59 50	3.5551	3.5552	3.5553	3.5555	3.5556	3.5557	3.5558	3.5559	3.5561	3.5562

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
^h ^m ^s										
0 0 0	3.5563	3.5564	3.5565	3.5567	3.5568	3.5569	3.5570	3.5571	3.5573	3.5574
0 10	3.5575	3.5576	3.5577	3.5579	3.5580	3.5581	3.5582	3.5583	3.5585	3.5586
0 20	3.5587	3.5588	3.5589	3.5591	3.5592	3.5593	3.5594	3.5595	3.5597	3.5598
0 30	3.5599	3.5600	3.5601	3.5603	3.5604	3.5605	3.5606	3.5607	3.5609	3.5610
0 40	3.5611	3.5612	3.5613	3.5615	3.5616	3.5617	3.5618	3.5619	3.5621	3.5622
0 50	3.5623	3.5624	3.5625	3.5626	3.5628	3.5629	3.5630	3.5631	3.5632	3.5634
1 1 0	3.5635	3.5636	3.5637	3.5638	3.5640	3.5641	3.5642	3.5643	3.5644	3.5645
1 10	3.5647	3.5648	3.5649	3.5650	3.5651	3.5653	3.5654	3.5655	3.5656	3.5657
1 20	3.5658	3.5660	3.5661	3.5662	3.5663	3.5664	3.5666	3.5667	3.5668	3.5669
1 30	3.5670	3.5671	3.5673	3.5674	3.5675	3.5676	3.5677	3.5678	3.5680	3.5681
1 40	3.5682	3.5683	3.5684	3.5686	3.5687	3.5688	3.5689	3.5690	3.5691	3.5693
1 50	3.5694	3.5695	3.5696	3.5697	3.5698	3.5700	3.5701	3.5702	3.5703	3.5704
1 2 0	3.5705	3.5707	3.5708	3.5709	3.5710	3.5711	3.5712	3.5714	3.5715	3.5716
2 10	3.5717	3.5718	3.5719	3.5721	3.5722	3.5723	3.5724	3.5725	3.5726	3.5728
2 20	3.5729	3.5730	3.5731	3.5732	3.5733	3.5735	3.5736	3.5737	3.5738	3.5739
2 30	3.5740	3.5741	3.5742	3.5744	3.5745	3.5746	3.5747	3.5748	3.5750	3.5751
2 40	3.5752	3.5753	3.5754	3.5755	3.5756	3.5758	3.5759	3.5760	3.5761	3.5762
2 50	3.5763	3.5765	3.5766	3.5767	3.5768	3.5769	3.5770	3.5771	3.5773	3.5774
1 3 0	3.5775	3.5776	3.5777	3.5778	3.5780	3.5781	3.5782	3.5783	3.5784	3.5785
3 10	3.5786	3.5788	3.5789	3.5790	3.5791	3.5792	3.5793	3.5794	3.5796	3.5797
3 20	3.5798	3.5799	3.5800	3.5801	3.5802	3.5804	3.5805	3.5806	3.5807	3.5808
3 30	3.5809	3.5810	3.5812	3.5813	3.5814	3.5815	3.5816	3.5817	3.5818	3.5819
3 40	3.5821	3.5822	3.5823	3.5824	3.5825	3.5826	3.5827	3.5829	3.5830	3.5831
3 50	3.5832	3.5833	3.5834	3.5835	3.5837	3.5838	3.5839	3.5840	3.5841	3.5842
1 4 0	3.5843	3.5844	3.5846	3.5847	3.5848	3.5849	3.5850	3.5851	3.5852	3.5853
4 10	3.5855	3.5856	3.5857	3.5858	3.5859	3.5860	3.5861	3.5862	3.5864	3.5865
4 20	3.5866	3.5867	3.5868	3.5869	3.5870	3.5871	3.5873	3.5874	3.5875	3.5876
4 30	3.5877	3.5878	3.5879	3.5880	3.5882	3.5883	3.5884	3.5885	3.5886	3.5887
4 40	3.5888	3.5889	3.5891	3.5892	3.5893	3.5894	3.5895	3.5896	3.5897	3.5898
4 50	3.5899	3.5901	3.5902	3.5903	3.5904	3.5905	3.5906	3.5907	3.5908	3.5910
1 5 0	3.5911	3.5912	3.5913	3.5914	3.5915	3.5916	3.5917	3.5918	3.5920	3.5921
5 10	3.5922	3.5923	3.5924	3.5925	3.5926	3.5927	3.5928	3.5930	3.5931	3.5932
5 20	3.5933	3.5934	3.5935	3.5936	3.5937	3.5938	3.5940	3.5941	3.5942	3.5943
5 30	3.5944	3.5945	3.5946	3.5947	3.5948	3.5949	3.5951	3.5952	3.5953	3.5954
5 40	3.5955	3.5956	3.5957	3.5958	3.5959	3.5960	3.5962	3.5963	3.5964	3.5965
5 50	3.5966	3.5967	3.5968	3.5969	3.5970	3.5971	3.5973	3.5974	3.5975	3.5976
1 6 0	3.5977	3.5978	3.5979	3.5980	3.5981	3.5982	3.5984	3.5985	3.5986	3.5987
6 10	3.5988	3.5989	3.5990	3.5991	3.5992	3.5993	3.5994	3.5996	3.5997	3.5998
6 20	3.5999	3.6000	3.6001	3.6002	3.6003	3.6004	3.6005	3.6006	3.6008	3.6009
6 30	3.6010	3.6011	3.6012	3.6013	3.6014	3.6015	3.6016	3.6017	3.6018	3.6020
6 40	3.6021	3.6022	3.6023	3.6024	3.6025	3.6026	3.6027	3.6028	3.6029	3.6030
6 50	3.6031	3.6033	3.6034	3.6035	3.6036	3.6037	3.6038	3.6039	3.6040	3.6041
1 7 0	3.6042	3.6043	3.6044	3.6046	3.6047	3.6048	3.6049	3.6050	3.6051	3.6052
7 10	3.6053	3.6054	3.6055	3.6056	3.6057	3.6058	3.6060	3.6061	3.6062	3.6063
7 20	3.6064	3.6065	3.6066	3.6067	3.6068	3.6069	3.6070	3.6071	3.6072	3.6073
7 30	3.6075	3.6076	3.6077	3.6078	3.6079	3.6080	3.6081	3.6082	3.6083	3.6084
7 40	3.6085	3.6086	3.6087	3.6088	3.6090	3.6091	3.6092	3.6093	3.6094	3.6095
7 50	3.6096	3.6097	3.6098	3.6099	3.6100	3.6101	3.6102	3.6103	3.6104	3.6106
1 8 0	3.6107	3.6108	3.6109	3.6110	3.6111	3.6112	3.6113	3.6114	3.6115	3.6116
8 10	3.6117	3.6118	3.6119	3.6120	3.6121	3.6123	3.6124	3.6125	3.6126	3.6127
8 20	3.6128	3.6129	3.6130	3.6131	3.6132	3.6133	3.6134	3.6135	3.6136	3.6137
8 30	3.6138	3.6139	3.6141	3.6142	3.6143	3.6144	3.6145	3.6146	3.6147	3.6148
8 40	3.6149	3.6150	3.6151	3.6152	3.6153	3.6154	3.6155	3.6156	3.6157	3.6158
8 50	3.6160	3.6161	3.6162	3.6163	3.6164	3.6165	3.6166	3.6167	3.6168	3.6169
1 9 0	3.6170	3.6171	3.6172	3.6173	3.6174	3.6175	3.6176	3.6177	3.6178	3.6179
9 10	3.6180	3.6182	3.6183	3.6184	3.6185	3.6186	3.6187	3.6188	3.6189	3.6190
9 20	3.6191	3.6192	3.6193	3.6194	3.6195	3.6196	3.6197	3.6198	3.6199	3.6200
9 30	3.6201	3.6202	3.6203	3.6204	3.6206	3.6207	3.6208	3.6209	3.6210	3.6211
9 40	3.6212	3.6213	3.6214	3.6215	3.6216	3.6217	3.6218	3.6219	3.6220	3.6221
9 50	3.6222	3.6223	3.6224	3.6225	3.6226	3.6227	3.6228	3.6229	3.6230	3.6231

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
$1^{\circ} 10^m$	3.6232	3.6234	3.6235	3.6236	3.6237	3.6238	3.6239	3.6240	3.6241	3.6242
10 10	3.6243	3.6244	3.6245	3.6246	3.6247	3.6248	3.6249	3.6250	3.6251	3.6252
10 20	3.6253	3.6254	3.6255	3.6256	3.6257	3.6258	3.6259	3.6260	3.6261	3.6262
10 30	3.6263	3.6264	3.6265	3.6266	3.6268	3.6269	3.6270	3.6271	3.6272	3.6273
10 40	3.6274	3.6275	3.6276	3.6277	3.6278	3.6279	3.6280	3.6281	3.6282	3.6283
10 50	3.6284	3.6285	3.6286	3.6287	3.6288	3.6289	3.6290	3.6291	3.6292	3.6293
1 11 0	3.6294	3.6295	3.6296	3.6297	3.5298	3.6299	3.6300	3.6301	3.6302	3.6303
11 10	3.6304	3.6305	3.6306	3.6307	3.6308	3.6309	3.6310	3.6311	3.6312	3.6313
11 20	3.6314	3.6315	3.6316	3.6317	3.6318	3.6320	3.6321	3.6322	3.6323	3.6324
11 30	3.6325	3.6326	3.6327	3.6328	3.6329	3.6330	3.6331	3.6332	3.6333	3.6334
11 40	3.6335	3.6336	3.6337	3.6338	3.6339	3.6340	3.6341	3.6342	3.6343	3.6344
11 50	3.6345	3.6346	3.6347	3.6348	3.6349	3.6350	3.6351	3.6352	3.6353	3.6354
1 12 0	3.6355	3.6356	3.6357	3.6358	3.6359	3.6360	3.6361	3.6362	3.6363	3.6364
12 10	3.6365	3.6366	3.6367	3.6368	3.6369	3.6370	3.6371	3.6372	3.6373	3.6374
12 20	3.6375	3.6376	3.6377	3.6378	3.6379	3.6380	3.6381	3.6382	3.6383	3.6384
12 30	3.6385	3.6386	3.6387	3.6388	3.6389	3.6390	3.6391	3.6392	3.6393	3.6394
12 40	3.6395	3.6396	3.6397	3.6398	3.6399	3.6400	3.6401	3.6402	3.6403	3.6404
12 50	3.6405	3.6406	3.6407	3.6408	3.6409	3.6410	3.6411	3.6412	3.6413	3.6414
1 13 0	3.6415	3.6416	3.6417	3.6418	3.6419	3.6420	3.6421	3.6422	3.6423	3.6424
13 10	3.6425	3.6426	3.6427	3.6428	3.6429	3.6430	3.6431	3.6432	3.6433	3.6434
13 20	3.6435	3.6436	3.6437	3.6438	3.6439	3.6440	3.6441	3.6442	3.6443	3.6444
13 30	3.6444	3.6445	3.6446	3.6447	3.6448	3.6449	3.6450	3.6451	3.6452	3.6453
13 40	3.6454	3.6455	3.6456	3.6457	3.6458	3.6459	3.6460	3.6461	3.6462	3.6463
13 50	3.6464	3.6465	3.6466	3.6467	3.6468	3.6469	3.6470	3.6471	3.6472	3.6473
1 14 0	3.6474	3.6475	3.6476	3.6477	3.6478	3.6479	3.6480	3.6481	3.6482	3.6483
14 10	3.6484	3.6485	3.6486	3.6487	3.6488	3.6489	3.6490	3.6491	3.6492	3.6493
14 20	3.6494	3.6495	3.6496	3.6497	3.6498	3.6499	3.6500	3.6501	3.6502	3.6503
14 30	3.6504	3.6505	3.6506	3.6507	3.6508	3.6509	3.6510	3.6511	3.6512	3.6513
14 40	3.6514	3.6515	3.6516	3.6517	3.6518	3.6519	3.6520	3.6521	3.6522	3.6523
14 50	3.6524	3.6525	3.6526	3.6527	3.6528	3.6529	3.6530	3.6531	3.6532	3.6533
1 15 0	3.6534	3.6535	3.6536	3.6537	3.6538	3.6539	3.6540	3.6541	3.6542	3.6543
15 10	3.6544	3.6545	3.6546	3.6547	3.6548	3.6549	3.6550	3.6551	3.6552	3.6553
15 20	3.6554	3.6555	3.6556	3.6557	3.6558	3.6559	3.6560	3.6561	3.6562	3.6563
15 30	3.6564	3.6565	3.6566	3.6567	3.6568	3.6569	3.6570	3.6571	3.6572	3.6573
15 40	3.6574	3.6575	3.6576	3.6577	3.6578	3.6579	3.6580	3.6581	3.6582	3.6583
15 50	3.6584	3.6585	3.6586	3.6587	3.6588	3.6589	3.6590	3.6591	3.6592	3.6593
1 16 0	3.6594	3.6595	3.6596	3.6597	3.6598	3.6599	3.6600	3.6601	3.6602	3.6603
16 10	3.6604	3.6605	3.6606	3.6607	3.6608	3.6609	3.6610	3.6611	3.6612	3.6613
16 20	3.6614	3.6615	3.6616	3.6617	3.6618	3.6619	3.6620	3.6621	3.6622	3.6623
16 30	3.6624	3.6625	3.6626	3.6627	3.6628	3.6629	3.6630	3.6631	3.6632	3.6633
16 40	3.6634	3.6635	3.6636	3.6637	3.6638	3.6639	3.6640	3.6641	3.6642	3.6643
16 50	3.6644	3.6645	3.6646	3.6647	3.6648	3.6649	3.6650	3.6651	3.6652	3.6653
1 17 0	3.6654	3.6655	3.6656	3.6657	3.6658	3.6659	3.6660	3.6661	3.6662	3.6663
17 10	3.6664	3.6665	3.6666	3.6667	3.6668	3.6669	3.6670	3.6671	3.6672	3.6673
17 20	3.6674	3.6675	3.6676	3.6677	3.6678	3.6679	3.6680	3.6681	3.6682	3.6683
17 30	3.6684	3.6685	3.6686	3.6687	3.6688	3.6689	3.6690	3.6691	3.6692	3.6693
17 40	3.6694	3.6695	3.6696	3.6697	3.6698	3.6699	3.6700	3.6701	3.6702	3.6703
17 50	3.6704	3.6705	3.6706	3.6707	3.6708	3.6709	3.6710	3.6711	3.6712	3.6713
1 18 0	3.6714	3.6715	3.6716	3.6717	3.6718	3.6719	3.6720	3.6721	3.6722	3.6723
18 10	3.6724	3.6725	3.6726	3.6727	3.6728	3.6729	3.6730	3.6731	3.6732	3.6733
18 20	3.6734	3.6735	3.6736	3.6737	3.6738	3.6739	3.6740	3.6741	3.6742	3.6743
18 30	3.6744	3.6745	3.6746	3.6747	3.6748	3.6749	3.6750	3.6751	3.6752	3.6753
18 40	3.6754	3.6755	3.6756	3.6757	3.6758	3.6759	3.6760	3.6761	3.6762	3.6763
18 50	3.6764	3.6765	3.6766	3.6767	3.6768	3.6769	3.6770	3.6771	3.6772	3.6773
1 19 0	3.6774	3.6775	3.6776	3.6777	3.6778	3.6779	3.6780	3.6781	3.6782	3.6783
19 10	3.6784	3.6785	3.6786	3.6787	3.6788	3.6789	3.6790	3.6791	3.6792	3.6793
19 20	3.6794	3.6795	3.6796	3.6797	3.6798	3.6799	3.6800	3.6801	3.6802	3.6803
19 30	3.6804	3.6805	3.6806	3.6807	3.6808	3.6809	3.6810	3.6811	3.6812	3.6813
19 40										
19 50										

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
$1^{\circ} 20' 0''$	3.6812	3.6813	3.6814	3.6815	3.6816	3.6817	3.6818	3.6819	3.6820	3.6821
20 10	3.6821	3.6822	3.6823	3.6824	3.6825	3.6826	3.6827	3.6828	3.6829	3.6830
20 20	3.6830	3.6831	3.6832	3.6833	3.6834	3.6835	3.6836	3.6837	3.6838	3.6839
20 30	3.6839	3.6840	3.6841	3.6842	3.6843	3.6844	3.6845	3.6846	3.6847	3.6848
20 40	3.6848	3.6849	3.6850	3.6851	3.6852	3.6853	3.6854	3.6855	3.6856	3.6857
20 50	3.6857	3.6858	3.6859	3.6860	3.6861	3.6862	3.6863	3.6864	3.6865	3.6866
1 21 0	3.6866	3.6867	3.6868	3.6869	3.6870	3.6871	3.6872	3.6873	3.6874	3.6875
21 10	3.6875	3.6876	3.6877	3.6878	3.6879	3.6880	3.6881	3.6882	3.6883	3.6884
21 20	3.6884	3.6885	3.6886	3.6887	3.6888	3.6889	3.6890	3.6891	3.6892	3.6893
21 30	3.6893	3.6894	3.6895	3.6896	3.6897	3.6898	3.6899	3.6900	3.6901	3.6902
21 40	3.6902	3.6903	3.6904	3.6905	3.6906	3.6907	3.6908	3.6909	3.6910	3.6911
21 50	3.6911	3.6912	3.6913	3.6914	3.6915	3.6916	3.6917	3.6918	3.6919	3.6920
1 22 0	3.6920	3.6921	3.6922	3.6923	3.6924	3.6925	3.6926	3.6927	3.6928	3.6929
22 10	3.6928	3.6929	3.6930	3.6931	3.6932	3.6933	3.6934	3.6935	3.6936	3.6937
22 20	3.6937	3.6938	3.6939	3.6940	3.6941	3.6942	3.6943	3.6944	3.6945	3.6946
22 30	3.6946	3.6947	3.6948	3.6949	3.6950	3.6951	3.6952	3.6953	3.6954	3.6955
22 40	3.6955	3.6956	3.6957	3.6958	3.6959	3.6960	3.6961	3.6962	3.6963	3.6964
22 50	3.6964	3.6965	3.6966	3.6967	3.6968	3.6969	3.6970	3.6971	3.6972	3.6973
1 23 0	3.6972	3.6973	3.6974	3.6975	3.6976	3.6977	3.6978	3.6979	3.6980	3.6981
23 10	3.6981	3.6982	3.6983	3.6984	3.6985	3.6986	3.6987	3.6988	3.6989	3.6990
23 20	3.6990	3.6991	3.6992	3.6993	3.6994	3.6995	3.6996	3.6997	3.6998	3.6999
23 30	3.6998	3.6999	3.7000	3.7001	3.7002	3.7003	3.7004	3.7005	3.7006	3.7007
23 40	3.7007	3.7008	3.7009	3.7010	3.7011	3.7012	3.7013	3.7014	3.7015	3.7016
23 50	3.7016	3.7017	3.7018	3.7019	3.7020	3.7021	3.7022	3.7023	3.7024	3.7025
1 24 0	3.7024	3.7025	3.7026	3.7027	3.7028	3.7029	3.7030	3.7031	3.7032	3.7033
24 10	3.7033	3.7034	3.7035	3.7036	3.7037	3.7038	3.7039	3.7040	3.7041	3.7042
24 20	3.7042	3.7043	3.7044	3.7045	3.7046	3.7047	3.7048	3.7049	3.7050	3.7051
24 30	3.7050	3.7051	3.7052	3.7053	3.7054	3.7055	3.7056	3.7057	3.7058	3.7059
24 40	3.7059	3.7060	3.7061	3.7062	3.7063	3.7064	3.7065	3.7066	3.7067	3.7068
24 50	3.7067	3.7068	3.7069	3.7070	3.7071	3.7072	3.7073	3.7074	3.7075	3.7076
1 25 0	3.7076	3.7077	3.7078	3.7079	3.7080	3.7081	3.7082	3.7083	3.7084	3.7085
25 10	3.7084	3.7085	3.7086	3.7087	3.7088	3.7089	3.7090	3.7091	3.7092	3.7093
25 20	3.7093	3.7094	3.7095	3.7096	3.7097	3.7098	3.7099	3.7100	3.7101	3.7102
25 30	3.7101	3.7102	3.7103	3.7104	3.7105	3.7106	3.7107	3.7108	3.7109	3.7110
25 40	3.7110	3.7111	3.7112	3.7113	3.7114	3.7115	3.7116	3.7117	3.7118	3.7119
25 50	3.7118	3.7119	3.7120	3.7121	3.7122	3.7123	3.7124	3.7125	3.7126	3.7127
1 26 0	3.7126	3.7127	3.7128	3.7129	3.7130	3.7131	3.7132	3.7133	3.7134	3.7135
26 10	3.7135	3.7136	3.7137	3.7138	3.7139	3.7140	3.7141	3.7142	3.7143	3.7144
26 20	3.7143	3.7144	3.7145	3.7146	3.7147	3.7148	3.7149	3.7150	3.7151	3.7152
26 30	3.7152	3.7153	3.7154	3.7155	3.7156	3.7157	3.7158	3.7159	3.7160	3.7161
26 40	3.7160	3.7161	3.7162	3.7163	3.7164	3.7165	3.7166	3.7167	3.7168	3.7169
26 50	3.7168	3.7169	3.7170	3.7171	3.7172	3.7173	3.7174	3.7175	3.7176	3.7177
1 27 0	3.7177	3.7178	3.7179	3.7180	3.7181	3.7182	3.7183	3.7184	3.7185	3.7186
27 10	3.7185	3.7186	3.7187	3.7188	3.7189	3.7190	3.7191	3.7192	3.7193	3.7194
27 20	3.7193	3.7194	3.7195	3.7196	3.7197	3.7198	3.7199	3.7200	3.7201	3.7202
27 30	3.7201	3.7202	3.7203	3.7204	3.7205	3.7206	3.7207	3.7208	3.7209	3.7210
27 40	3.7210	3.7211	3.7212	3.7213	3.7214	3.7215	3.7216	3.7217	3.7218	3.7219
27 50	3.7218	3.7219	3.7220	3.7221	3.7222	3.7223	3.7224	3.7225	3.7226	3.7227
1 28 0	3.7226	3.7227	3.7228	3.7229	3.7230	3.7231	3.7232	3.7233	3.7234	3.7235
28 10	3.7235	3.7236	3.7237	3.7238	3.7239	3.7240	3.7241	3.7242	3.7243	3.7244
28 20	3.7243	3.7244	3.7245	3.7246	3.7247	3.7248	3.7249	3.7250	3.7251	3.7252
28 30	3.7251	3.7252	3.7253	3.7254	3.7255	3.7256	3.7257	3.7258	3.7259	3.7260
28 40	3.7259	3.7260	3.7261	3.7262	3.7263	3.7264	3.7265	3.7266	3.7267	3.7268
28 50	3.7267	3.7268	3.7269	3.7270	3.7271	3.7272	3.7273	3.7274	3.7275	3.7276
1 29 0	3.7275	3.7276	3.7277	3.7278	3.7279	3.7280	3.7281	3.7282	3.7283	3.7284
29 10	3.7284	3.7285	3.7286	3.7287	3.7288	3.7289	3.7290	3.7291	3.7292	3.7293
29 20	3.7292	3.7293	3.7294	3.7295	3.7296	3.7297	3.7298	3.7299	3.7300	3.7301
29 30	3.7300	3.7301	3.7302	3.7303	3.7304	3.7305	3.7306	3.7307	3.7308	3.7309
29 40	3.7308	3.7309	3.7310	3.7311	3.7312	3.7313	3.7314	3.7315	3.7316	3.7317
29 50	3.7316	3.7317	3.7318	3.7319	3.7320	3.7321	3.7322	3.7323	3.7324	3.7325

TABLE X.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
0 ^h 30 ^m 0 ^s .	3.7324	3.7325	3.7326	3.7326	3.7327	3.7328	3.7329	3.7330	3.7330	3.7331
30 10	3.7332	3.7333	3.7334	3.7334	3.7335	3.7336	3.7337	3.7338	3.7338	3.7339
30 20	3.7340	3.7341	3.7342	3.7342	3.7343	3.7344	3.7345	3.7346	3.7346	3.7347
30 30	3.7348	3.7349	3.7350	3.7350	3.7351	3.7352	3.7353	3.7354	3.7354	3.7355
30 40	3.7356	3.7357	3.7358	3.7358	3.7359	3.7360	3.7361	3.7362	3.7362	3.7363
30 50	3.7364	3.7365	3.7366	3.7366	3.7367	3.7368	3.7369	3.7370	3.7370	3.7371
1 31 0	3.7372	3.7373	3.7374	3.7374	3.7375	3.7376	3.7377	3.7377	3.7378	3.7379
31 10	3.7380	3.7381	3.7381	3.7382	3.7383	3.7384	3.7385	3.7385	3.7386	3.7387
31 20	3.7388	3.7389	3.7389	3.7390	3.7391	3.7392	3.7393	3.7393	3.7394	3.7395
31 30	3.7396	3.7397	3.7397	3.7398	3.7399	3.7400	3.7400	3.7401	3.7402	3.7403
31 40	3.7404	3.7404	3.7405	3.7406	3.7407	3.7408	3.7408	3.7409	3.7410	3.7411
31 50	3.7412	3.7412	3.7413	3.7414	3.7415	3.7415	3.7416	3.7417	3.7418	3.7419
1 32 0	3.7419	3.7420	3.7421	3.7422	3.7423	3.7423	3.7424	3.7425	3.7426	3.7426
32 10	3.7427	3.7428	3.7429	3.7430	3.7430	3.7431	3.7432	3.7433	3.7434	3.7434
32 20	3.7435	3.7436	3.7437	3.7437	3.7438	3.7439	3.7440	3.7441	3.7441	3.7442
32 30	3.7443	3.7444	3.7444	3.7445	3.7446	3.7447	3.7448	3.7448	3.7449	3.7450
32 40	3.7451	3.7452	3.7452	3.7453	3.7454	3.7455	3.7455	3.7456	3.7457	3.7458
32 50	3.7459	3.7459	3.7460	3.7461	3.7462	3.7462	3.7463	3.7464	3.7465	3.7466
1 33 0	3.7466	3.7467	3.7468	3.7469	3.7469	3.7470	3.7471	3.7472	3.7473	3.7473
33 10	3.7474	3.7475	3.7476	3.7476	3.7477	3.7478	3.7479	3.7480	3.7480	3.7481
33 20	3.7482	3.7483	3.7483	3.7484	3.7485	3.7486	3.7487	3.7487	3.7488	3.7489
33 30	3.7490	3.7490	3.7491	3.7492	3.7493	3.7493	3.7494	3.7495	3.7496	3.7497
33 40	3.7497	3.7498	3.7499	3.7500	3.7500	3.7501	3.7502	3.7503	3.7504	3.7504
33 50	3.7505	3.7506	3.7507	3.7507	3.7508	3.7509	3.7510	3.7510	3.7511	3.7512
1 34 0	3.7513	3.7514	3.7514	3.7515	3.7516	3.7517	3.7517	3.7518	3.7519	3.7520
34 10	3.7520	3.7521	3.7522	3.7523	3.7524	3.7524	3.7525	3.7526	3.7527	3.7527
34 20	3.7528	3.7529	3.7530	3.7530	3.7531	3.7532	3.7533	3.7534	3.7534	3.7535
34 30	3.7536	3.7537	3.7537	3.7538	3.7539	3.7540	3.7540	3.7541	3.7542	3.7543
34 40	3.7543	3.7544	3.7545	3.7546	3.7547	3.7547	3.7548	3.7549	3.7550	3.7550
34 50	3.7551	3.7552	3.7553	3.7553	3.7554	3.7555	3.7556	3.7556	3.7557	3.7558
1 35 0	3.7559	3.7560	3.7560	3.7561	3.7562	3.7563	3.7563	3.7564	3.7565	3.7566
35 10	3.7566	3.7567	3.7568	3.7569	3.7569	3.7570	3.7571	3.7572	3.7572	3.7573
35 20	3.7574	3.7575	3.7575	3.7576	3.7577	3.7578	3.7579	3.7579	3.7580	3.7581
35 30	3.7582	3.7582	3.7583	3.7584	3.7585	3.7585	3.7586	3.7587	3.7588	3.7588
35 40	3.7589	3.7590	3.7591	3.7591	3.7592	3.7593	3.7594	3.7594	3.7595	3.7596
35 50	3.7597	3.7597	3.7598	3.7599	3.7600	3.7600	3.7601	3.7602	3.7603	3.7603
1 36 0	3.7604	3.7605	3.7606	3.7606	3.7607	3.7608	3.7609	3.7609	3.7610	3.7611
36 10	3.7612	3.7613	3.7613	3.7614	3.7615	3.7616	3.7616	3.7617	3.7618	3.7619
36 20	3.7619	3.7620	3.7621	3.7622	3.7622	3.7623	3.7624	3.7625	3.7625	3.7626
36 30	3.7627	3.7628	3.7628	3.7629	3.7630	3.7631	3.7631	3.7632	3.7633	3.7634
36 40	3.7634	3.7635	3.7636	3.7637	3.7637	3.7638	3.7639	3.7640	3.7640	3.7641
36 50	3.7642	3.7643	3.7643	3.7644	3.7645	3.7645	3.7646	3.7647	3.7648	3.7648
1 37 0	3.7649	3.7650	3.7651	3.7651	3.7652	3.7653	3.7654	3.7654	3.7655	3.7656
37 10	3.7657	3.7657	3.7658	3.7659	3.7660	3.7660	3.7661	3.7662	3.7663	3.7663
37 20	3.7664	3.7665	3.7666	3.7666	3.7667	3.7668	3.7669	3.7669	3.7670	3.7671
37 30	3.7672	3.7672	3.7673	3.7674	3.7675	3.7675	3.7676	3.7677	3.7677	3.7678
37 40	3.7679	3.7680	3.7681	3.7681	3.7682	3.7683	3.7683	3.7684	3.7685	3.7686
37 50	3.7686	3.7687	3.7688	3.7689	3.7689	3.7690	3.7691	3.7692	3.7692	3.7693
1 38 0	3.7694	3.7695	3.7695	3.7696	3.7697	3.7697	3.7698	3.7699	3.7700	3.7700
38 10	3.7701	3.7702	3.7703	3.7703	3.7704	3.7705	3.7706	3.7706	3.7707	3.7708
38 20	3.7709	3.7709	3.7710	3.7711	3.7711	3.7712	3.7713	3.7714	3.7714	3.7715
38 30	3.7716	3.7717	3.7717	3.7718	3.7719	3.7720	3.7720	3.7721	3.7722	3.7722
38 40	3.7723	3.7724	3.7725	3.7725	3.7726	3.7727	3.7728	3.7728	3.7729	3.7730
38 50	3.7731	3.7731	3.7732	3.7733	3.7733	3.7734	3.7735	3.7736	3.7736	3.7737
1 39 0	3.7738	3.7739	3.7739	3.7740	3.7741	3.7742	3.7742	3.7743	3.7744	3.7744
39 10	3.7745	3.7746	3.7747	3.7747	3.7748	3.7749	3.7750	3.7750	3.7751	3.7752
39 20	3.7752	3.7753	3.7754	3.7755	3.7755	3.7756	3.7757	3.7758	3.7758	3.7759
39 30	3.7760	3.7760	3.7761	3.7762	3.7763	3.7763	3.7764	3.7765	3.7766	3.7766
39 40	3.7767	3.7768	3.7768	3.7769	3.7770	3.7771	3.7771	3.7772	3.7773	3.7774
39 50	3.7774	3.7775	3.7776	3.7776	3.7777	3.7778	3.7779	3.7779	3.7780	3.7781

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
$1^{\circ} 40' 0''$	3.7782	3.7782	3.7783	3.7784	3.7784	3.7785	3.7786	3.7787	3.7787	3.7788
40 10	3.7789	3.7789	3.7790	3.7791	3.7792	3.7792	3.7793	3.7794	3.7795	3.7795
40 20	3.7796	3.7797	3.7797	3.7798	3.7799	3.7800	3.7800	3.7801	3.7802	3.7802
40 30	3.7803	3.7804	3.7805	3.7805	3.7806	3.7807	3.7807	3.7808	3.7809	3.7810
40 40	3.7810	3.7811	3.7812	3.7813	3.7813	3.7814	3.7815	3.7815	3.7816	3.7817
40 50	3.7818	3.7818	3.7819	3.7820	3.7820	3.7821	3.7822	3.7823	3.7823	3.7824
1 41 0	3.7825	3.7825	3.7826	3.7827	3.7828	3.7828	3.7829	3.7830	3.7830	3.7831
41 10	3.7832	3.7833	3.7833	3.7834	3.7835	3.7835	3.7836	3.7837	3.7838	3.7838
41 20	3.7839	3.7840	3.7840	3.7841	3.7842	3.7843	3.7843	3.7844	3.7845	3.7845
41 30	3.7846	3.7847	3.7848	3.7848	3.7849	3.7850	3.7850	3.7851	3.7852	3.7853
41 40	3.7853	3.7854	3.7855	3.7855	3.7856	3.7857	3.7858	3.7858	3.7859	3.7860
41 50	3.7860	3.7861	3.7862	3.7863	3.7863	3.7864	3.7865	3.7865	3.7866	3.7867
1 42 0	3.7868	3.7868	3.7869	3.7870	3.7870	3.7871	3.7872	3.7872	3.7873	3.7874
42 10	3.7875	3.7875	3.7876	3.7877	3.7877	3.7878	3.7879	3.7880	3.7880	3.7881
42 20	3.7882	3.7882	3.7883	3.7884	3.7885	3.7885	3.7886	3.7887	3.7887	3.7888
42 30	3.7889	3.7889	3.7890	3.7891	3.7892	3.7892	3.7893	3.7894	3.7894	3.7895
42 40	3.7896	3.7897	3.7897	3.7898	3.7899	3.7899	3.7900	3.7901	3.7901	3.7902
42 50	3.7903	3.7904	3.7904	3.7905	3.7906	3.7906	3.7907	3.7908	3.7908	3.7909
1 43 0	3.7910	3.7911	3.7911	3.7912	3.7913	3.7913	3.7914	3.7915	3.7916	3.7916
43 10	3.7917	3.7918	3.7918	3.7919	3.7920	3.7920	3.7921	3.7922	3.7923	3.7923
43 20	3.7924	3.7925	3.7925	3.7926	3.7927	3.7927	3.7928	3.7929	3.7930	3.7930
43 30	3.7931	3.7932	3.7932	3.7933	3.7934	3.7934	3.7935	3.7936	3.7937	3.7937
43 40	3.7938	3.7939	3.7939	3.7940	3.7941	3.7941	3.7942	3.7943	3.7943	3.7944
43 50	3.7945	3.7946	3.7946	3.7947	3.7948	3.7948	3.7949	3.7950	3.7950	3.7951
1 44 0	3.7952	3.7953	3.7953	3.7954	3.7955	3.7955	3.7956	3.7957	3.7957	3.7958
44 10	3.7959	3.7959	3.7960	3.7961	3.7962	3.7962	3.7963	3.7964	3.7964	3.7965
44 20	3.7966	3.7966	3.7967	3.7968	3.7969	3.7969	3.7970	3.7971	3.7971	3.7972
44 30	3.7973	3.7973	3.7974	3.7975	3.7975	3.7976	3.7977	3.7978	3.7978	3.7979
44 40	3.7980	3.7980	3.7981	3.7982	3.7982	3.7983	3.7984	3.7984	3.7985	3.7986
44 50	3.7987	3.7987	3.7988	3.7989	3.7989	3.7990	3.7991	3.7991	3.7992	3.7993
1 45 0	3.7993	3.7994	3.7995	3.7995	3.7996	3.7997	3.7998	3.7998	3.7999	3.8000
45 10	3.8000	3.8001	3.8002	3.8002	3.8003	3.8004	3.8004	3.8005	3.8006	3.8006
45 20	3.8007	3.8008	3.8009	3.8009	3.8010	3.8011	3.8011	3.8012	3.8013	3.8013
45 30	3.8014	3.8015	3.8015	3.8016	3.8017	3.8017	3.8018	3.8019	3.8020	3.8020
45 40	3.8021	3.8022	3.8022	3.8023	3.8024	3.8024	3.8025	3.8026	3.8026	3.8027
45 50	3.8028	3.8028	3.8029	3.8030	3.8030	3.8031	3.8032	3.8033	3.8033	3.8034
1 46 0	3.8035	3.8035	3.8036	3.8036	3.8037	3.8038	3.8039	3.8039	3.8040	3.8041
46 10	3.8041	3.8042	3.8043	3.8043	3.8044	3.8045	3.8045	3.8046	3.8047	3.8048
46 20	3.8048	3.8049	3.8050	3.8050	3.8051	3.8052	3.8052	3.8053	3.8054	3.8054
46 30	3.8055	3.8056	3.8056	3.8057	3.8058	3.8058	3.8059	3.8060	3.8060	3.8061
46 40	3.8062	3.8062	3.8063	3.8064	3.8065	3.8065	3.8066	3.8067	3.8067	3.8068
46 50	3.8069	3.8069	3.8070	3.8071	3.8071	3.8072	3.8073	3.8073	3.8074	3.8075
1 47 0	3.8075	3.8076	3.8077	3.8077	3.8078	3.8079	3.8079	3.8080	3.8081	3.8081
47 10	3.8082	3.8083	3.8083	3.8084	3.8085	3.8085	3.8086	3.8087	3.8088	3.8088
47 20	3.8089	3.8090	3.8090	3.8091	3.8092	3.8092	3.8093	3.8094	3.8094	3.8095
47 30	3.8096	3.8096	3.8097	3.8098	3.8098	3.8099	3.8099	3.8100	3.8101	3.8102
47 40	3.8102	3.8103	3.8104	3.8104	3.8105	3.8106	3.8106	3.8107	3.8108	3.8108
47 50	3.8109	3.8110	3.8110	3.8111	3.8112	3.8112	3.8113	3.8114	3.8114	3.8115
1 48 0	3.8116	3.8116	3.8117	3.8118	3.8118	3.8119	3.8120	3.8120	3.8121	3.8122
48 10	3.8122	3.8123	3.8124	3.8124	3.8125	3.8126	3.8126	3.8127	3.8128	3.8128
48 20	3.8129	3.8130	3.8130	3.8131	3.8132	3.8132	3.8133	3.8134	3.8134	3.8135
48 30	3.8136	3.8136	3.8137	3.8138	3.8138	3.8139	3.8140	3.8140	3.8141	3.8142
48 40	3.8142	3.8143	3.8144	3.8144	3.8145	3.8146	3.8146	3.8147	3.8148	3.8148
48 50	3.8149	3.8150	3.8150	3.8151	3.8152	3.8152	3.8153	3.8154	3.8154	3.8155
1 49 0	3.8156	3.8156	3.8157	3.8158	3.8158	3.8159	3.8160	3.8160	3.8161	3.8162
49 10	3.8162	3.8163	3.8164	3.8164	3.8165	3.8166	3.8166	3.8167	3.8168	3.8168
49 20	3.8169	3.8170	3.8170	3.8171	3.8172	3.8172	3.8173	3.8174	3.8174	3.8175
49 30	3.8176	3.8176	3.8177	3.8178	3.8178	3.8179	3.8180	3.8180	3.8181	3.8182
49 40	3.8182	3.8183	3.8184	3.8184	3.8185	3.8185	3.8186	3.8187	3.8188	3.8188
49 50	3.8189	3.8190	3.8190	3.8191	3.8191	3.8192	3.8193	3.8193	3.8194	3.8195

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
1 ^h . 50 ^m . 0 ^s .	3.8195	3.8196	3.8197	3.8197	3.8198	3.8199	3.8199	3.8200	3.8201	3.8201
50 10	3.8202	3.8203	3.8203	3.8204	3.8205	3.8205	3.8206	3.8207	3.8207	3.8208
50 20	3.8209	3.8209	3.8210	3.8211	3.8211	3.8212	3.8213	3.8213	3.8214	3.8214
50 30	3.8215	3.8216	3.8216	3.8217	3.8218	3.8218	3.8219	3.8220	3.8220	3.8221
50 40	3.8222	3.8222	3.8223	3.8224	3.8224	3.8225	3.8226	3.8226	3.8227	3.8228
50 50	3.8228	3.8229	3.8230	3.8230	3.8231	3.8231	3.8232	3.8233	3.8233	3.8234
1 51 0	3.8235	3.8235	3.8236	3.8237	3.8237	3.8238	3.8239	3.8239	3.8240	3.8241
51 10	3.8241	3.8242	3.8243	3.8243	3.8244	3.8245	3.8245	3.8246	3.8246	3.8247
51 20	3.8248	3.8248	3.8249	3.8250	3.8250	3.8251	3.8252	3.8252	3.8253	3.8254
51 30	3.8254	3.8255	3.8256	3.8256	3.8257	3.8258	3.8258	3.8259	3.8259	3.8260
51 40	3.8261	3.8261	3.8262	3.8263	3.8263	3.8264	3.8265	3.8265	3.8266	3.8267
51 50	3.8267	3.8268	3.8269	3.8269	3.8270	3.8270	3.8271	3.8272	3.8272	3.8273
1 52 0	3.8274	3.8274	3.8275	3.8276	3.8276	3.8277	3.8278	3.8278	3.8279	3.8280
52 10	3.8280	3.8281	3.8281	3.8282	3.8283	3.8283	3.8284	3.8285	3.8285	3.8286
52 20	3.8287	3.8287	3.8288	3.8289	3.8289	3.8290	3.8290	3.8291	3.8292	3.8292
52 30	3.8293	3.8294	3.8294	3.8295	3.8296	3.8296	3.8297	3.8298	3.8298	3.8299
52 40	3.8299	3.8300	3.8301	3.8301	3.8302	3.8303	3.8303	3.8304	3.8305	3.8305
52 50	3.8306	3.8307	3.8307	3.8308	3.8308	3.8309	3.8310	3.8310	3.8311	3.8312
1 53 0	3.8312	3.8313	3.8314	3.8314	3.8315	3.8315	3.8316	3.8317	3.8317	3.8318
53 10	3.8319	3.8319	3.8320	3.8321	3.8321	3.8322	3.8323	3.8323	3.8324	3.8324
53 20	3.8325	3.8326	3.8326	3.8327	3.8328	3.8328	3.8329	3.8330	3.8330	3.8331
53 30	3.8331	3.8332	3.8333	3.8333	3.8334	3.8335	3.8335	3.8336	3.8337	3.8337
53 40	3.8338	3.8338	3.8339	3.8340	3.8340	3.8341	3.8342	3.8342	3.8343	3.8344
53 50	3.8344	3.8345	3.8345	3.8346	3.8347	3.8347	3.8348	3.8349	3.8349	3.8350
1 54 0	3.8351	3.8351	3.8352	3.8352	3.8353	3.8354	3.8354	3.8355	3.8356	3.8356
54 10	3.8357	3.8358	3.8358	3.8359	3.8359	3.8360	3.8361	3.8361	3.8362	3.8363
54 20	3.8363	3.8364	3.8365	3.8365	3.8366	3.8366	3.8367	3.8368	3.8368	3.8369
54 30	3.8370	3.8370	3.8371	3.8371	3.8372	3.8373	3.8373	3.8374	3.8375	3.8375
54 40	3.8376	3.8377	3.8377	3.8378	3.8378	3.8379	3.8380	3.8380	3.8381	3.8382
54 50	3.8382	3.8383	3.8383	3.8384	3.8385	3.8385	3.8386	3.8387	3.8387	3.8388
1 55 0	3.8388	3.8389	3.8390	3.8390	3.8391	3.8392	3.8392	3.8393	3.8394	3.8394
55 10	3.8395	3.8395	3.8396	3.8397	3.8397	3.8398	3.8399	3.8399	3.8400	3.8400
55 20	3.8401	3.8402	3.8402	3.8403	3.8404	3.8404	3.8405	3.8405	3.8406	3.8407
55 30	3.8407	3.8408	3.8409	3.8409	3.8410	3.8410	3.8411	3.8412	3.8412	3.8413
55 40	3.8414	3.8414	3.8415	3.8415	3.8416	3.8417	3.8417	3.8418	3.8419	3.8419
55 50	3.8420	3.8420	3.8421	3.8422	3.8422	3.8423	3.8424	3.8424	3.8425	3.8425
1 56 0	3.8426	3.8427	3.8427	3.8428	3.8429	3.8429	3.8430	3.8430	3.8431	3.8432
56 10	3.8432	3.8433	3.8434	3.8434	3.8435	3.8435	3.8436	3.8437	3.8437	3.8438
56 20	3.8439	3.8439	3.8440	3.8440	3.8441	3.8442	3.8442	3.8443	3.8444	3.8444
56 30	3.8445	3.8445	3.8446	3.8447	3.8447	3.8448	3.8448	3.8449	3.8450	3.8450
56 40	3.8451	3.8452	3.8452	3.8453	3.8453	3.8454	3.8455	3.8455	3.8456	3.8457
56 50	3.8457	3.8458	3.8458	3.8459	3.8460	3.8460	3.8461	3.8462	3.8462	3.8463
1 57 0	3.8463	3.8464	3.8465	3.8465	3.8466	3.8466	3.8467	3.8468	3.8468	3.8469
57 10	3.8470	3.8470	3.8471	3.8471	3.8472	3.8473	3.8473	3.8474	3.8474	3.8475
57 20	3.8476	3.8476	3.8477	3.8478	3.8478	3.8479	3.8479	3.8480	3.8481	3.8481
57 30	3.8482	3.8483	3.8483	3.8484	3.8484	3.8485	3.8486	3.8486	3.8487	3.8487
57 40	3.8488	3.8489	3.8489	3.8490	3.8491	3.8491	3.8492	3.8492	3.8493	3.8494
57 50	3.8494	3.8495	3.8495	3.8496	3.8497	3.8497	3.8498	3.8499	3.8499	3.8500
1 58 0	3.8500	3.8501	3.8502	3.8502	3.8503	3.8503	3.8504	3.8505	3.8505	3.8506
58 10	3.8506	3.8507	3.8508	3.8508	3.8509	3.8510	3.8510	3.8511	3.8511	3.8512
58 20	3.8513	3.8513	3.8514	3.8514	3.8515	3.8516	3.8516	3.8517	3.8517	3.8518
58 30	3.8519	3.8519	3.8520	3.8521	3.8521	3.8522	3.8522	3.8523	3.8524	3.8524
58 40	3.8525	3.8525	3.8526	3.8527	3.8527	3.8528	3.8528	3.8529	3.8530	3.8530
58 50	3.8531	3.8532	3.8532	3.8533	3.8533	3.8534	3.8535	3.8535	3.8536	3.8536
1 59 0	3.8537	3.8538	3.8538	3.8539	3.8539	3.8540	3.8541	3.8541	3.8542	3.8542
59 10	3.8543	3.8544	3.8544	3.8545	3.8545	3.8546	3.8547	3.8547	3.8548	3.8549
59 20	3.8549	3.8550	3.8550	3.8551	3.8552	3.8552	3.8553	3.8553	3.8554	3.8555
59 30	3.8555	3.8556	3.8556	3.8557	3.8558	3.8558	3.8559	3.8559	3.8560	3.8561
59 40	3.8561	3.8562	3.8562	3.8563	3.8564	3.8564	3.8565	3.8565	3.8566	3.8567
59 50	3.8567	3.8568	3.8568	3.8569	3.8570	3.8570	3.8571	3.8572	3.8572	3.8573

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
0h. 0 ^m . 0 ^s .	3.8573	3.8574	3.8575	3.8575	3.8576	3.8576	3.8577	3.8578	3.8578	3.8579
0 10	3.8579	3.8580	3.8581	3.8581	3.8582	3.8582	3.8583	3.8584	3.8584	3.8585
0 20	3.8585	3.8586	3.8587	3.8587	3.8588	3.8588	3.8589	3.8590	3.8590	3.8591
0 30	3.8591	3.8592	3.8593	3.8593	3.8594	3.8594	3.8595	3.8596	3.8596	3.8597
0 40	3.8597	3.8598	3.8599	3.8599	3.8600	3.8600	3.8601	3.8602	3.8602	3.8603
0 50	3.8603	3.8604	3.8605	3.8605	3.8606	3.8606	3.8607	3.8608	3.8608	3.8609
2 1 0	3.8609	3.8610	3.8611	3.8611	3.8612	3.8612	3.8613	3.8614	3.8614	3.8615
1 10	3.8615	3.8616	3.8617	3.8617	3.8618	3.8618	3.8619	3.8620	3.8620	3.8621
1 20	3.8621	3.8622	3.8623	3.8623	3.8624	3.8624	3.8625	3.8625	3.8626	3.8627
1 30	3.8627	3.8628	3.8628	3.8629	3.8630	3.8630	3.8631	3.8631	3.8632	3.8633
1 40	3.8633	3.8634	3.8634	3.8635	3.8636	3.8636	3.8637	3.8637	3.8638	3.8639
1 50	3.8639	3.8640	3.8640	3.8641	3.8642	3.8642	3.8643	3.8643	3.8644	3.8645
2 2 0	3.8645	3.8646	3.8646	3.8647	3.8647	3.8648	3.8649	3.8649	3.8650	3.8650
2 2 10	3.8651	3.8652	3.8652	3.8653	3.8653	3.8654	3.8655	3.8655	3.8656	3.8656
2 2 20	3.8657	3.8658	3.8658	3.8659	3.8659	3.8660	3.8661	3.8661	3.8662	3.8662
2 2 30	3.8663	3.8663	3.8664	3.8665	3.8665	3.8666	3.8666	3.8667	3.8668	3.8668
2 2 40	3.8669	3.8669	3.8670	3.8671	3.8671	3.8672	3.8672	3.8673	3.8673	3.8674
2 2 50	3.8675	3.8675	3.8676	3.8676	3.8677	3.8678	3.8678	3.8679	3.8679	3.8680
2 3 0	3.8681	3.8681	3.8682	3.8682	3.8683	3.8684	3.8684	3.8685	3.8685	3.8686
2 3 10	3.8686	3.8687	3.8688	3.8688	3.8689	3.8689	3.8690	3.8691	3.8691	3.8692
2 3 20	3.8692	3.8693	3.8693	3.8694	3.8695	3.8695	3.8696	3.8696	3.8697	3.8698
2 3 30	3.8698	3.8699	3.8699	3.8700	3.8701	3.8701	3.8702	3.8702	3.8703	3.8703
2 3 40	3.8704	3.8705	3.8705	3.8706	3.8706	3.8707	3.8708	3.8708	3.8709	3.8709
2 3 50	3.8710	3.8710	3.8711	3.8712	3.8712	3.8713	3.8713	3.8714	3.8715	3.8715
2 4 0	3.8716	3.8716	3.8717	3.8717	3.8718	3.8719	3.8719	3.8720	3.8720	3.8721
2 4 10	3.8722	3.8722	3.8723	3.8723	3.8724	3.8724	3.8725	3.8726	3.8726	3.8727
2 4 20	3.8727	3.8728	3.8729	3.8729	3.8730	3.8730	3.8731	3.8731	3.8732	3.8733
2 4 30	3.8733	3.8734	3.8734	3.8735	3.8736	3.8736	3.8737	3.8737	3.8738	3.8738
2 4 40	3.8739	3.8740	3.8740	3.8741	3.8741	3.8742	3.8742	3.8743	3.8744	3.8744
2 4 50	3.8745	3.8745	3.8746	3.8747	3.8747	3.8748	3.8748	3.8749	3.8749	3.8750
2 5 0	3.8751	3.8751	3.8752	3.8752	3.8753	3.8754	3.8754	3.8755	3.8755	3.8756
2 5 10	3.8756	3.8757	3.8758	3.8758	3.8759	3.8759	3.8760	3.8760	3.8761	3.8762
2 5 20	3.8762	3.8763	3.8763	3.8764	3.8764	3.8765	3.8766	3.8766	3.8767	3.8767
2 5 30	3.8768	3.8769	3.8769	3.8770	3.8770	3.8771	3.8771	3.8772	3.8773	3.8773
2 5 40	3.8774	3.8774	3.8775	3.8775	3.8776	3.8777	3.8777	3.8778	3.8778	3.8779
2 5 50	3.8779	3.8780	3.8781	3.8781	3.8782	3.8782	3.8783	3.8783	3.8784	3.8785
2 6 0	3.8785	3.8786	3.8786	3.8787	3.8788	3.8788	3.8789	3.8789	3.8790	3.8790
2 6 10	3.8791	3.8792	3.8792	3.8793	3.8793	3.8794	3.8794	3.8795	3.8796	3.8796
2 6 20	3.8797	3.8797	3.8798	3.8798	3.8799	3.8800	3.8800	3.8801	3.8801	3.8802
2 6 30	3.8802	3.8803	3.8804	3.8804	3.8805	3.8805	3.8806	3.8806	3.8807	3.8808
2 6 40	3.8808	3.8809	3.8809	3.8810	3.8810	3.8811	3.8812	3.8812	3.8813	3.8813
2 6 50	3.8814	3.8814	3.8815	3.8816	3.8816	3.8817	3.8817	3.8818	3.8818	3.8819
2 7 0	3.8820	3.8820	3.8821	3.8821	3.8822	3.8822	3.8823	3.8824	3.8824	3.8825
2 7 10	3.8825	3.8826	3.8826	3.8827	3.8828	3.8828	3.8829	3.8829	3.8830	3.8830
2 7 20	3.8831	3.8832	3.8832	3.8833	3.8833	3.8834	3.8834	3.8835	3.8835	3.8836
2 7 30	3.8837	3.8837	3.8838	3.8838	3.8839	3.8839	3.8840	3.8841	3.8841	3.8842
2 7 40	3.8842	3.8843	3.8843	3.8844	3.8845	3.8845	3.8846	3.8846	3.8847	3.8847
2 7 50	3.8848	3.8849	3.8849	3.8850	3.8850	3.8851	3.8851	3.8852	3.8852	3.8853
2 8 0	3.8854	3.8854	3.8855	3.8855	3.8856	3.8856	3.8857	3.8858	3.8858	3.8859
2 8 10	3.8859	3.8860	3.8860	3.8861	3.8862	3.8862	3.8863	3.8863	3.8864	3.8864
2 8 20	3.8865	3.8865	3.8866	3.8867	3.8867	3.8868	3.8868	3.8869	3.8869	3.8870
2 8 30	3.8871	3.8871	3.8872	3.8872	3.8873	3.8873	3.8874	3.8874	3.8875	3.8876
2 8 40	3.8876	3.8877	3.8877	3.8878	3.8878	3.8879	3.8880	3.8880	3.8881	3.8881
2 8 50	3.8882	3.8882	3.8883	3.8883	3.8884	3.8885	3.8885	3.8886	3.8886	3.8887
2 9 0	3.8887	3.8888	3.8889	3.8889	3.8890	3.8890	3.8891	3.8891	3.8892	3.8892
2 9 10	3.8893	3.8894	3.8894	3.8895	3.8895	3.8896	3.8896	3.8897	3.8897	3.8898
2 9 20	3.8899	3.8899	3.8900	3.8900	3.8901	3.8901	3.8902	3.8903	3.8903	3.8904
2 9 30	3.8904	3.8905	3.8905	3.8906	3.8906	3.8907	3.8908	3.8908	3.8909	3.8909
2 9 40	3.8910	3.8910	3.8911	3.8911	3.8912	3.8912	3.8913	3.8914	3.8914	3.8915
2 9 50	3.8915	3.8916	3.8916	3.8917	3.8918	3.8918	3.8919	3.8919	3.8920	3.8920

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
$2^h 10^m 0^s$	3.8921	3.8922	3.8922	3.8923	3.8923	3.8924	3.8924	3.8925	3.8925	3.8926
10 10	3.8927	3.8927	3.8928	3.8928	3.8929	3.8929	3.8930	3.8930	3.8931	3.8932
10 20	3.8932	3.8933	3.8933	3.8934	3.8934	3.8935	3.8935	3.8936	3.8937	3.8937
10 30	3.8938	3.8938	3.8939	3.8939	3.8940	3.8940	3.8941	3.8941	3.8942	3.8943
10 40	3.8943	3.8944	3.8944	3.8945	3.8945	3.8946	3.8946	3.8947	3.8948	3.8948
10 50	3.8949	3.8949	3.8950	3.8950	3.8951	3.8951	3.8952	3.8953	3.8953	3.8954
2 11 0	3.8954	3.8955	3.8955	3.8956	3.8956	3.8957	3.8958	3.8958	3.8959	3.8959
11 10	3.8960	3.8960	3.8961	3.8961	3.8962	3.8963	3.8963	3.8964	3.8964	3.8965
11 20	3.8965	3.8966	3.8966	3.8967	3.8967	3.8968	3.8969	3.8969	3.8970	3.8970
11 30	3.8971	3.8971	3.8972	3.8972	3.8973	3.8974	3.8974	3.8975	3.8975	3.8976
11 40	3.8976	3.8977	3.8977	3.8978	3.8978	3.8979	3.8980	3.8980	3.8981	3.8981
11 50	3.8982	3.8982	3.8983	3.8983	3.8984	3.8985	3.8985	3.8986	3.8986	3.8987
2 12 0	3.8987	3.8988	3.8988	3.8989	3.8989	3.8990	3.8991	3.8991	3.8992	3.8992
12 10	3.8993	3.8993	3.8994	3.8994	3.8995	3.8995	3.8996	3.8997	3.8997	3.8998
12 20	3.8998	3.8999	3.8999	3.9000	3.9000	3.9001	3.9001	3.9002	3.9003	3.9003
12 30	3.9004	3.9004	3.9005	3.9005	3.9006	3.9006	3.9007	3.9007	3.9008	3.9009
12 40	3.9009	3.9010	3.9010	3.9011	3.9011	3.9012	3.9012	3.9013	3.9013	3.9014
12 50	3.9015	3.9015	3.9016	3.9016	3.9017	3.9017	3.9018	3.9018	3.9019	3.9019
2 13 0	3.9020	3.9021	3.9021	3.9022	3.9022	3.9023	3.9023	3.9024	3.9024	3.9025
13 10	3.9025	3.9026	3.9027	3.9027	3.9028	3.9028	3.9029	3.9029	3.9030	3.9030
13 20	3.9031	3.9031	3.9032	3.9033	3.9033	3.9034	3.9034	3.9035	3.9035	3.9036
13 30	3.9036	3.9037	3.9037	3.9038	3.9038	3.9039	3.9040	3.9040	3.9041	3.9041
13 40	3.9042	3.9042	3.9043	3.9043	3.9044	3.9044	3.9045	3.9046	3.9046	3.9047
13 50	3.9047	3.9048	3.9048	3.9049	3.9049	3.9050	3.9050	3.9051	3.9051	3.9052
2 14 0	3.9053	3.9053	3.9054	3.9054	3.9055	3.9055	3.9056	3.9056	3.9057	3.9057
14 10	3.9058	3.9058	3.9059	3.9060	3.9060	3.9061	3.9061	3.9062	3.9062	3.9063
14 20	3.9063	3.9064	3.9064	3.9065	3.9066	3.9066	3.9067	3.9067	3.9068	3.9068
14 30	3.9069	3.9069	3.9070	3.9070	3.9071	3.9071	3.9072	3.9073	3.9073	3.9074
14 40	3.9074	3.9075	3.9075	3.9076	3.9076	3.9077	3.9077	3.9078	3.9078	3.9079
14 50	3.9079	3.9080	3.9081	3.9081	3.9082	3.9082	3.9083	3.9083	3.9084	3.9084
2 15 0	3.9085	3.9085	3.9086	3.9086	3.9087	3.9088	3.9088	3.9089	3.9089	3.9090
15 10	3.9090	3.9091	3.9091	3.9092	3.9092	3.9093	3.9093	3.9094	3.9094	3.9095
15 20	3.9096	3.9096	3.9097	3.9097	3.9098	3.9098	3.9099	3.9099	3.9100	3.9100
15 30	3.9101	3.9101	3.9102	3.9103	3.9103	3.9104	3.9104	3.9105	3.9105	3.9106
15 40	3.9106	3.9107	3.9107	3.9108	3.9108	3.9109	3.9109	3.9110	3.9111	3.9111
15 50	3.9112	3.9112	3.9113	3.9113	3.9114	3.9114	3.9115	3.9115	3.9116	3.9116
2 16 0	3.9117	3.9117	3.9118	3.9118	3.9119	3.9120	3.9120	3.9121	3.9121	3.9122
16 10	3.9122	3.9123	3.9123	3.9124	3.9124	3.9125	3.9125	3.9126	3.9126	3.9127
16 20	3.9128	3.9128	3.9129	3.9129	3.9130	3.9130	3.9131	3.9131	3.9132	3.9132
16 30	3.9133	3.9133	3.9134	3.9134	3.9135	3.9135	3.9136	3.9137	3.9137	3.9138
16 40	3.9138	3.9139	3.9139	3.9140	3.9140	3.9141	3.9141	3.9142	3.9142	3.9143
16 50	3.9143	3.9144	3.9144	3.9145	3.9146	3.9146	3.9147	3.9147	3.9148	3.9148
2 17 0	3.9149	3.9149	3.9150	3.9150	3.9151	3.9151	3.9152	3.9152	3.9153	3.9153
17 10	3.9154	3.9155	3.9155	3.9156	3.9156	3.9157	3.9157	3.9158	3.9158	3.9159
17 20	3.9159	3.9160	3.9160	3.9161	3.9161	3.9162	3.9162	3.9163	3.9163	3.9164
17 30	3.9165	3.9165	3.9166	3.9166	3.9167	3.9167	3.9168	3.9168	3.9169	3.9169
17 40	3.9170	3.9170	3.9171	3.9171	3.9172	3.9172	3.9173	3.9173	3.9174	3.9175
17 50	3.9175	3.9176	3.9176	3.9177	3.9177	3.9178	3.9178	3.9179	3.9179	3.9180
2 18 0	3.9180	3.9181	3.9181	3.9182	3.9182	3.9183	3.9183	3.9184	3.9184	3.9185
18 10	3.9186	3.9186	3.9187	3.9187	3.9188	3.9188	3.9189	3.9189	3.9190	3.9190
18 20	3.9191	3.9191	3.9192	3.9192	3.9193	3.9193	3.9194	3.9194	3.9195	3.9195
18 30	3.9196	3.9197	3.9197	3.9198	3.9198	3.9199	3.9199	3.9200	3.9200	3.9201
18 40	3.9201	3.9202	3.9202	3.9203	3.9203	3.9204	3.9204	3.9205	3.9205	3.9206
18 50	3.9206	3.9207	3.9207	3.9208	3.9209	3.9209	3.9210	3.9210	3.9211	3.9211
2 19 0	3.9212	3.9212	3.9213	3.9213	3.9214	3.9214	3.9215	3.9215	3.9216	3.9216
19 10	3.9217	3.9217	3.9218	3.9218	3.9219	3.9219	3.9220	3.9221	3.9221	3.9222
19 20	3.9222	3.9223	3.9223	3.9224	3.9224	3.9225	3.9225	3.9226	3.9226	3.9227
19 30	3.9227	3.9228	3.9228	3.9229	3.9229	3.9230	3.9230	3.9231	3.9231	3.9232
19 40	3.9232	3.9233	3.9233	3.9234	3.9235	3.9235	3.9236	3.9236	3.9237	3.9237
19 50	3.9238	3.9238	3.9239	3.9239	3.9240	3.9240	3.9241	3.9241	3.9242	3.9242

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
2 ^h 20 ^m 0 ^s	3.9243	3.9243	3.9244	3.9244	3.9245	3.9245	3.9246	3.9246	3.9247	3.9247
20 10	3.9248	3.9248	3.9249	3.9250	3.9250	3.9251	3.9251	3.9252	3.9252	3.9253
20 20	3.9253	3.9254	3.9254	3.9255	3.9255	3.9256	3.9256	3.9257	3.9257	3.9258
20 30	3.9258	3.9259	3.9259	3.9260	3.9260	3.9261	3.9261	3.9262	3.9262	3.9263
20 40	3.9263	3.9264	3.9264	3.9265	3.9265	3.9266	3.9267	3.9267	3.9268	3.9268
20 50	3.9269	3.9269	3.9270	3.9270	3.9271	3.9271	3.9272	3.9272	3.9273	3.9273
2 21 0	3.9274	3.9274	3.9275	3.9275	3.9276	3.9276	3.9277	3.9277	3.9278	3.9278
21 10	3.9279	3.9279	3.9280	3.9280	3.9281	3.9281	3.9282	3.9282	3.9283	3.9283
21 20	3.9284	3.9284	3.9285	3.9285	3.9286	3.9287	3.9287	3.9288	3.9288	3.9289
21 30	3.9289	3.9290	3.9290	3.9291	3.9291	3.9292	3.9292	3.9293	3.9293	3.9294
21 40	3.9294	3.9295	3.9295	3.9296	3.9296	3.9297	3.9297	3.9298	3.9298	3.9299
21 50	3.9299	3.9300	3.9300	3.9301	3.9301	3.9302	3.9302	3.9303	3.9303	3.9304
2 22 0	3.9304	3.9305	3.9305	3.9306	3.9306	3.9307	3.9307	3.9308	3.9308	3.9309
22 10	3.9309	3.9310	3.9311	3.9311	3.9312	3.9312	3.9313	3.9313	3.9314	3.9314
22 20	3.9315	3.9315	3.9316	3.9316	3.9317	3.9317	3.9318	3.9318	3.9319	3.9319
22 30	3.9320	3.9320	3.9321	3.9321	3.9322	3.9322	3.9323	3.9323	3.9324	3.9324
22 40	3.9325	3.9325	3.9326	3.9326	3.9327	3.9327	3.9328	3.9328	3.9329	3.9329
22 50	3.9330	3.9330	3.9331	3.9331	3.9332	3.9332	3.9333	3.9333	3.9334	3.9334
2 23 0	3.9335	3.9335	3.9336	3.9336	3.9337	3.9337	3.9338	3.9338	3.9339	3.9339
23 10	3.9340	3.9340	3.9341	3.9341	3.9342	3.9342	3.9343	3.9343	3.9344	3.9344
23 20	3.9345	3.9345	3.9346	3.9346	3.9347	3.9348	3.9348	3.9349	3.9349	3.9350
23 30	3.9350	3.9351	3.9351	3.9352	3.9352	3.9353	3.9353	3.9354	3.9354	3.9355
23 40	3.9355	3.9356	3.9356	3.9357	3.9357	3.9358	3.9358	3.9359	3.9359	3.9360
23 50	3.9360	3.9361	3.9361	3.9362	3.9362	3.9363	3.9363	3.9364	3.9364	3.9365
2 24 0	3.9365	3.9366	3.9366	3.9367	3.9367	3.9368	3.9368	3.9369	3.9369	3.9370
24 10	3.9370	3.9371	3.9371	3.9372	3.9372	3.9373	3.9373	3.9374	3.9374	3.9375
24 20	3.9375	3.9376	3.9376	3.9377	3.9377	3.9378	3.9378	3.9379	3.9379	3.9380
24 30	3.9380	3.9381	3.9381	3.9382	3.9382	3.9383	3.9383	3.9384	3.9384	3.9385
24 40	3.9385	3.9386	3.9386	3.9387	3.9387	3.9388	3.9388	3.9389	3.9389	3.9390
24 50	3.9390	3.9391	3.9391	3.9392	3.9392	3.9393	3.9393	3.9394	3.9394	3.9395
2 25 0	3.9395	3.9396	3.9396	3.9397	3.9397	3.9398	3.9398	3.9399	3.9399	3.9400
25 10	3.9400	3.9401	3.9401	3.9402	3.9402	3.9403	3.9403	3.9404	3.9404	3.9405
25 20	3.9405	3.9406	3.9406	3.9407	3.9407	3.9408	3.9408	3.9409	3.9409	3.9410
25 30	3.9410	3.9411	3.9411	3.9412	3.9412	3.9413	3.9413	3.9414	3.9414	3.9415
25 40	3.9415	3.9416	3.9416	3.9417	3.9417	3.9418	3.9418	3.9419	3.9419	3.9420
25 50	3.9420	3.9421	3.9421	3.9422	3.9422	3.9423	3.9423	3.9424	3.9424	3.9425
2 26 0	3.9425	3.9426	3.9426	3.9427	3.9427	3.9428	3.9428	3.9429	3.9429	3.9430
26 10	3.9430	3.9430	3.9431	3.9431	3.9432	3.9432	3.9433	3.9433	3.9434	3.9434
26 20	3.9435	3.9435	3.9436	3.9436	3.9437	3.9437	3.9438	3.9438	3.9439	3.9439
26 30	3.9440	3.9440	3.9441	3.9441	3.9442	3.9442	3.9443	3.9443	3.9444	3.9444
26 40	3.9445	3.9445	3.9446	3.9446	3.9447	3.9447	3.9448	3.9448	3.9449	3.9449
26 50	3.9450	3.9450	3.9451	3.9451	3.9452	3.9452	3.9453	3.9453	3.9454	3.9454
2 27 0	3.9455	3.9455	3.9456	3.9456	3.9457	3.9457	3.9458	3.9458	3.9459	3.9459
27 10	3.9460	3.9460	3.9461	3.9461	3.9462	3.9462	3.9463	3.9463	3.9464	3.9464
27 20	3.9465	3.9465	3.9466	3.9466	3.9467	3.9467	3.9468	3.9468	3.9469	3.9469
27 30	3.9469	3.9470	3.9470	3.9471	3.9471	3.9472	3.9472	3.9473	3.9473	3.9474
27 40	3.9474	3.9475	3.9475	3.9476	3.9476	3.9477	3.9477	3.9478	3.9478	3.9479
27 50	3.9479	3.9480	3.9480	3.9481	3.9481	3.9482	3.9482	3.9483	3.9483	3.9484
2 28 0	3.9484	3.9485	3.9485	3.9486	3.9486	3.9487	3.9487	3.9488	3.9488	3.9489
28 10	3.9489	3.9490	3.9490	3.9490	3.9491	3.9491	3.9492	3.9492	3.9493	3.9493
28 20	3.9494	3.9494	3.9495	3.9495	3.9496	3.9496	3.9497	3.9497	3.9498	3.9498
28 30	3.9499	3.9499	3.9500	3.9500	3.9501	3.9501	3.9502	3.9502	3.9503	3.9503
28 40	3.9504	3.9504	3.9505	3.9505	3.9506	3.9506	3.9507	3.9507	3.9508	3.9508
28 50	3.9509	3.9509	3.9509	3.9510	3.9510	3.9511	3.9511	3.9512	3.9512	3.9513
2 29 0	3.9513	3.9514	3.9514	3.9515	3.9515	3.9516	3.9516	3.9517	3.9517	3.9518
29 10	3.9518	3.9519	3.9519	3.9520	3.9520	3.9521	3.9521	3.9522	3.9522	3.9523
29 20	3.9523	3.9524	3.9524	3.9525	3.9525	3.9526	3.9526	3.9527	3.9527	3.9528
29 30	3.9528	3.9528	3.9529	3.9529	3.9530	3.9530	3.9531	3.9531	3.9532	3.9532
29 40	3.9533	3.9533	3.9534	3.9534	3.9535	3.9535	3.9536	3.9536	3.9537	3.9537
29 50	3.9538	3.9538	3.9539	3.9539	3.9540	3.9540	3.9540	3.9541	3.9541	3.9542

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
2 ^h 30 ^m 0 ^s	3.9542	3.9543	3.9543	3.9544	3.9544	3.9545	3.9545	3.9546	3.9546	3.9547
30 10	3.9547	3.9548	3.9548	3.9549	3.9549	3.9550	3.9550	3.9551	3.9551	3.9552
30 20	3.9552	3.9553	3.9553	3.9554	3.9554	3.9555	3.9555	3.9555	3.9556	3.9556
30 30	3.9557	3.9557	3.9558	3.9558	3.9559	3.9559	3.9560	3.9560	3.9561	3.9561
30 40	3.9562	3.9562	3.9563	3.9563	3.9564	3.9564	3.9565	3.9565	3.9566	3.9566
30 50	3.9566	3.9567	3.9567	3.9568	3.9568	3.9569	3.9569	3.9570	3.9570	3.9571
2 31 0	3.9571	3.9572	3.9572	3.9573	3.9573	3.9574	3.9574	3.9575	3.9575	3.9576
31 10	3.9576	3.9577	3.9577	3.9578	3.9578	3.9578	3.9579	3.9579	3.9580	3.9580
31 20	3.9581	3.9581	3.9582	3.9582	3.9583	3.9583	3.9584	3.9584	3.9585	3.9585
31 30	3.9586	3.9586	3.9587	3.9587	3.9588	3.9588	3.9589	3.9589	3.9589	3.9590
31 40	3.9590	3.9591	3.9591	3.9592	3.9592	3.9593	3.9593	3.9594	3.9594	3.9595
31 50	3.9595	3.9596	3.9596	3.9607	3.9597	3.9598	3.9598	3.9599	3.9599	3.9599
2 32 0	3.9600	3.9600	3.9601	3.9601	3.9602	3.9602	3.9603	3.9603	3.9604	3.9604
32 10	3.9605	3.9605	3.9606	3.9606	3.9607	3.9607	3.9608	3.9608	3.9609	3.9609
32 20	3.9609	3.9610	3.9610	3.9611	3.9611	3.9612	3.9612	3.9613	3.9613	3.9614
32 30	3.9614	3.9615	3.9615	3.9616	3.9616	3.9617	3.9617	3.9618	3.9618	3.9618
32 40	3.9619	3.9619	3.9620	3.9620	3.9621	3.9621	3.9622	3.9622	3.9623	3.9623
32 50	3.9624	3.9624	3.9625	3.9625	3.9626	3.9626	3.9627	3.9627	3.9627	3.9628
2 33 0	3.9628	3.9629	3.9629	3.9630	3.9630	3.9631	3.9631	3.9632	3.9632	3.9633
33 10	3.9633	3.9634	3.9634	3.9634	3.9635	3.9635	3.9636	3.9636	3.9637	3.9637
33 20	3.9638	3.9638	3.9639	3.9639	3.9640	3.9640	3.9641	3.9641	3.9642	3.9642
33 30	3.9642	3.9643	3.9643	3.9644	3.9644	3.9645	3.9645	3.9646	3.9646	3.9647
33 40	3.9647	3.9648	3.9648	3.9649	3.9649	3.9650	3.9650	3.9651	3.9651	3.9652
33 50	3.9652	3.9653	3.9653	3.9653	3.9654	3.9654	3.9655	3.9655	3.9656	3.9656
2 34 0	3.9657	3.9657	3.9658	3.9658	3.9658	3.9659	3.9659	3.9660	3.9660	3.9661
34 10	3.9661	3.9662	3.9662	3.9663	3.9663	3.9664	3.9664	3.9665	3.9665	3.9665
34 20	3.9666	3.9666	3.9667	3.9667	3.9668	3.9668	3.9669	3.9669	3.9670	3.9670
34 30	3.9671	3.9671	3.9672	3.9672	3.9672	3.9673	3.9673	3.9674	3.9674	3.9675
34 40	3.9675	3.9676	3.9676	3.9677	3.9677	3.9678	3.9678	3.9679	3.9679	3.9680
34 50	3.9680	3.9681	3.9681	3.9682	3.9682	3.9682	3.9683	3.9683	3.9684	3.9684
2 35 0	3.9685	3.9685	3.9686	3.9686	3.9687	3.9687	3.9688	3.9688	3.9689	3.9689
35 10	3.9689	3.9690	3.9690	3.9691	3.9691	3.9692	3.9692	3.9693	3.9693	3.9694
35 20	3.9694	3.9695	3.9695	3.9696	3.9696	3.9696	3.9697	3.9697	3.9698	3.9698
35 30	3.9699	3.9699	3.9700	3.9700	3.9701	3.9701	3.9702	3.9702	3.9703	3.9703
35 40	3.9703	3.9704	3.9704	3.9705	3.9705	3.9706	3.9706	3.9707	3.9707	3.9708
35 50	3.9708	3.9709	3.9709	3.9710	3.9710	3.9710	3.9711	3.9711	3.9712	3.9712
2 36 0	3.9713	3.9713	3.9714	3.9714	3.9715	3.9715	3.9716	3.9716	3.9716	3.9717
36 10	3.9717	3.9718	3.9718	3.9719	3.9719	3.9720	3.9720	3.9721	3.9721	3.9722
36 20	3.9722	3.9722	3.9723	3.9723	3.9724	3.9724	3.9725	3.9725	3.9726	3.9726
36 30	3.9727	3.9727	3.9728	3.9728	3.9729	3.9729	3.9729	3.9730	3.9730	3.9731
36 40	3.9731	3.9732	3.9732	3.9733	3.9733	3.9734	3.9734	3.9735	3.9735	3.9735
36 50	3.9736	3.9736	3.9737	3.9737	3.9738	3.9738	3.9739	3.9739	3.9740	3.9740
2 37 0	3.9741	3.9741	3.9741	3.9742	3.9742	3.9743	3.9743	3.9744	3.9744	3.9745
37 10	3.9745	3.9746	3.9746	3.9746	3.9747	3.9747	3.9748	3.9748	3.9749	3.9749
37 20	3.9750	3.9750	3.9751	3.9751	3.9752	3.9752	3.9752	3.9753	3.9753	3.9754
37 30	3.9754	3.9755	3.9755	3.9756	3.9756	3.9757	3.9757	3.9758	3.9758	3.9758
37 40	3.9759	3.9759	3.9760	3.9760	3.9761	3.9761	3.9762	3.9762	3.9763	3.9763
37 50	3.9763	3.9764	3.9764	3.9765	3.9765	3.9766	3.9766	3.9767	3.9767	3.9768
2 38 0	3.9768	3.9769	3.9769	3.9769	3.9770	3.9770	3.9771	3.9771	3.9772	3.9772
38 10	3.9773	3.9773	3.9774	3.9774	3.9774	3.9775	3.9775	3.9776	3.9776	3.9777
38 20	3.9777	3.9778	3.9778	3.9779	3.9779	3.9779	3.9780	3.9780	3.9781	3.9781
38 30	3.9782	3.9782	3.9783	3.9783	3.9784	3.9784	3.9785	3.9785	3.9785	3.9786
38 40	3.9786	3.9787	3.9787	3.9788	3.9788	3.9789	3.9789	3.9790	3.9790	3.9790
38 50	3.9791	3.9791	3.9792	3.9792	3.9793	3.9793	3.9794	3.9794	3.9795	3.9795
2 39 0	3.9795	3.9796	3.9796	3.9797	3.9797	3.9798	3.9798	3.9799	3.9799	3.9800
39 10	3.9800	3.9800	3.9801	3.9801	3.9802	3.9802	3.9803	3.9803	3.9804	3.9804
39 20	3.9805	3.9805	3.9805	3.9806	3.9806	3.9807	3.9807	3.9808	3.9808	3.9809
39 30	3.9809	3.9810	3.9810	3.9810	3.9811	3.9811	3.9812	3.9812	3.9813	3.9813
39 40	3.9814	3.9814	3.9815	3.9815	3.9815	3.9816	3.9816	3.9817	3.9817	3.9818
39 50	3.9818	3.9819	3.9819	3.9819	3.9820	3.9820	3.9821	3.9821	3.9822	3.9822

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
2 ^h 40 ^m 0 ^s	3.9823	3.9823	3.9824	3.9824	3.9825	3.9825	3.9825	3.9826	3.9826	3.9827
40 10	3.9827	3.9828	3.9828	3.9829	3.9829	3.9829	3.9830	3.9830	3.9831	3.9831
40 20	3.9832	3.9832	3.9833	3.9833	3.9834	3.9834	3.9834	3.9835	3.9835	3.9836
40 30	3.9836	3.9837	3.9837	3.9838	3.9838	3.9839	3.9839	3.9839	3.9840	3.9840
40 40	3.9841	3.9841	3.9842	3.9842	3.9843	3.9843	3.9843	3.9844	3.9844	3.9845
40 50	3.9845	3.9846	3.9846	3.9847	3.9847	3.9848	3.9848	3.9848	3.9849	3.9849
2 41 0	3.9850	3.9850	3.9851	3.9851	3.9852	3.9852	3.9852	3.9853	3.9853	3.9854
41 10	3.9854	3.9855	3.9855	3.9856	3.9856	3.9857	3.9857	3.9857	3.9858	3.9858
41 20	3.9859	3.9859	3.9860	3.9860	3.9861	3.9861	3.9861	3.9862	3.9862	3.9863
41 30	3.9863	3.9864	3.9864	3.9865	3.9865	3.9865	3.9866	3.9866	3.9867	3.9867
41 40	3.9868	3.9868	3.9869	3.9869	3.9870	3.9870	3.9870	3.9871	3.9871	3.9872
41 50	3.9872	3.9873	3.9873	3.9874	3.9874	3.9874	3.9875	3.9875	3.9876	3.9876
2 42 0	3.9877	3.9877	3.9878	3.9878	3.9878	3.9879	3.9879	3.9880	3.9880	3.9881
42 10	3.9881	3.9882	3.9882	3.9882	3.9883	3.9883	3.9884	3.9884	3.9885	3.9885
42 20	3.9886	3.9886	3.9886	3.9887	3.9887	3.9888	3.9888	3.9889	3.9889	3.9890
42 30	3.9890	3.9890	3.9891	3.9891	3.9892	3.9892	3.9893	3.9893	3.9894	3.9894
42 40	3.9894	3.9895	3.9895	3.9896	3.9896	3.9897	3.9897	3.9898	3.9898	3.9898
42 50	3.9899	3.9899	3.9900	3.9900	3.9901	3.9901	3.9902	3.9902	3.9903	3.9903
2 43 0	3.9903	3.9904	3.9904	3.9905	3.9905	3.9906	3.9906	3.9906	3.9907	3.9907
43 10	3.9908	3.9908	3.9909	3.9909	3.9910	3.9910	3.9910	3.9911	3.9911	3.9912
43 20	3.9912	3.9913	3.9913	3.9914	3.9914	3.9914	3.9915	3.9915	3.9916	3.9916
43 30	3.9917	3.9917	3.9918	3.9918	3.9918	3.9919	3.9919	3.9920	3.9920	3.9921
43 40	3.9921	3.9922	3.9922	3.9922	3.9923	3.9923	3.9924	3.9924	3.9925	3.9925
43 50	3.9926	3.9926	3.9926	3.9927	3.9927	3.9928	3.9928	3.9929	3.9929	3.9930
2 44 0	3.9930	3.9930	3.9931	3.9931	3.9932	3.9932	3.9933	3.9933	3.9933	3.9934
44 10	3.9934	3.9935	3.9935	3.9936	3.9936	3.9937	3.9937	3.9937	3.9938	3.9938
44 20	3.9939	3.9939	3.9940	3.9940	3.9941	3.9941	3.9941	3.9942	3.9942	3.9943
44 30	3.9943	3.9944	3.9944	3.9944	3.9945	3.9945	3.9946	3.9946	3.9947	3.9947
44 40	3.9948	3.9948	3.9948	3.9949	3.9949	3.9950	3.9950	3.9951	3.9951	3.9952
44 50	3.9952	3.9952	3.9953	3.9953	3.9954	3.9954	3.9955	3.9955	3.9955	3.9956
2 45 0	3.9956	3.9957	3.9957	3.9958	3.9958	3.9959	3.9959	3.9959	3.9960	3.9960
45 10	3.9961	3.9961	3.9962	3.9962	3.9962	3.9963	3.9963	3.9964	3.9964	3.9965
45 20	3.9965	3.9966	3.9966	3.9966	3.9967	3.9967	3.9968	3.9968	3.9969	3.9969
45 30	3.9969	3.9970	3.9970	3.9971	3.9971	3.9972	3.9972	3.9973	3.9973	3.9974
45 40	3.9974	3.9974	3.9975	3.9975	3.9976	3.9976	3.9976	3.9977	3.9977	3.9978
45 50	3.9978	3.9979	3.9979	3.9980	3.9980	3.9980	3.9981	3.9981	3.9982	3.9982
2 46 0	3.9983	3.9983	3.9983	3.9984	3.9984	3.9985	3.9985	3.9986	3.9986	3.9987
46 10	3.9987	3.9987	3.9988	3.9988	3.9989	3.9989	3.9990	3.9990	3.9990	3.9991
46 20	3.9991	3.9992	3.9992	3.9993	3.9993	3.9993	3.9994	3.9994	3.9995	3.9995
46 30	3.9996	3.9996	3.9997	3.9997	3.9997	3.9998	3.9998	3.9999	3.9999	4.0000
46 40	4.0000	4.0000	4.0001	4.0001	4.0002	4.0002	4.0003	4.0003	4.0003	4.0004
46 50	4.0004	4.0005	4.0005	4.0006	4.0006	4.0007	4.0007	4.0007	4.0008	4.0008
2 47 0	4.0009	4.0009	4.0010	4.0010	4.0010	4.0011	4.0011	4.0012	4.0012	4.0013
47 10	4.0013	4.0013	4.0014	4.0014	4.0015	4.0015	4.0016	4.0016	4.0016	4.0017
47 20	4.0017	4.0018	4.0018	4.0019	4.0019	4.0019	4.0020	4.0020	4.0021	4.0021
47 30	4.0022	4.0022	4.0023	4.0023	4.0023	4.0024	4.0024	4.0025	4.0025	4.0026
47 40	4.0026	4.0026	4.0027	4.0027	4.0028	4.0028	4.0029	4.0029	4.0029	4.0030
47 50	4.0030	4.0031	4.0031	4.0032	4.0032	4.0032	4.0033	4.0033	4.0034	4.0034
2 48 0	4.0035	4.0035	4.0035	4.0036	4.0036	4.0037	4.0037	4.0038	4.0038	4.0038
48 10	4.0039	4.0039	4.0040	4.0040	4.0041	4.0041	4.0041	4.0042	4.0042	4.0043
48 20	4.0043	4.0044	4.0044	4.0045	4.0045	4.0045	4.0046	4.0046	4.0047	4.0047
48 30	4.0048	4.0048	4.0048	4.0049	4.0049	4.0050	4.0050	4.0051	4.0051	4.0051
48 40	4.0052	4.0052	4.0053	4.0053	4.0054	4.0054	4.0054	4.0055	4.0055	4.0056
48 50	4.0056	4.0057	4.0057	4.0057	4.0058	4.0058	4.0059	4.0059	4.0060	4.0060
2 49 0	4.0060	4.0061	4.0061	4.0062	4.0062	4.0063	4.0063	4.0063	4.0064	4.0064
49 10	4.0065	4.0065	4.0066	4.0066	4.0066	4.0067	4.0067	4.0068	4.0068	4.0069
49 20	4.0069	4.0069	4.0070	4.0070	4.0071	4.0071	4.0072	4.0072	4.0072	4.0073
49 30	4.0073	4.0074	4.0074	4.0074	4.0075	4.0075	4.0076	4.0076	4.0077	4.0077
49 40	4.0077	4.0078	4.0078	4.0079	4.0079	4.0080	4.0080	4.0080	4.0081	4.0081
49 50	4.0082	4.0082	4.0083	4.0083	4.0083	4.0084	4.0084	4.0085	4.0085	4.0086

TABLE IX.

LOGARITHMS OF SMALL ARCS IN SPACE OR TIME.

Arc.	0	1	2	3	4	5	6	7	8	9
0h. 50m. 0s.	4.0086	4.0086	4.0087	4.0087	4.0088	4.0088	4.0089	4.0089	4.0089	4.0090
50 10	4.0090	4.0091	4.0091	4.0092	4.0092	4.0092	4.0093	4.0093	4.0094	4.0094
50 20	4.0095	4.0095	4.0095	4.0096	4.0096	4.0097	4.0097	4.0097	4.0098	4.0098
50 30	4.0099	4.0099	4.0100	4.0100	4.0100	4.0101	4.0101	4.0102	4.0102	4.0103
50 40	4.0103	4.0103	4.0104	4.0104	4.0105	4.0105	4.0106	4.0106	4.0106	4.0107
50 50	4.0107	4.0108	4.0108	4.0109	4.0109	4.0109	4.0110	4.0110	4.0111	4.0111
2 51 0	4.0111	4.0112	4.0112	4.0113	4.0113	4.0114	4.0114	4.0114	4.0115	4.0115
51 10	4.0116	4.0116	4.0117	4.0117	4.0117	4.0118	4.0118	4.0119	4.0119	4.0120
51 20	4.0120	4.0120	4.0121	4.0121	4.0122	4.0122	4.0122	4.0123	4.0123	4.0124
51 30	4.0124	4.0125	4.0125	4.0125	4.0126	4.0126	4.0127	4.0127	4.0128	4.0128
51 40	4.0128	4.0129	4.0129	4.0130	4.0130	4.0130	4.0131	4.0131	4.0132	4.0132
51 50	4.0133	4.0133	4.0133	4.0134	4.0134	4.0135	4.0135	4.0136	4.0136	4.0136
2 52 0	4.0137	4.0137	4.0138	4.0138	4.0138	4.0139	4.0139	4.0140	4.0140	4.0141
52 10	4.0141	4.0141	4.0142	4.0142	4.0143	4.0143	4.0144	4.0144	4.0144	4.0145
52 20	4.0145	4.0146	4.0146	4.0146	4.0147	4.0147	4.0148	4.0148	4.0149	4.0149
52 30	4.0149	4.0150	4.0150	4.0151	4.0151	4.0152	4.0152	4.0153	4.0153	4.0153
52 40	4.0154	4.0154	4.0154	4.0155	4.0155	4.0156	4.0156	4.0157	4.0157	4.0157
52 50	4.0158	4.0158	4.0159	4.0159	4.0159	4.0160	4.0160	4.0161	4.0161	4.0162
2 53 0	4.0162	4.0162	4.0163	4.0163	4.0164	4.0164	4.0164	4.0165	4.0165	4.0166
53 10	4.0166	4.0167	4.0167	4.0167	4.0168	4.0168	4.0169	4.0169	4.0169	4.0170
53 20	4.0170	4.0171	4.0171	4.0172	4.0172	4.0172	4.0173	4.0173	4.0174	4.0174
53 30	4.0175	4.0175	4.0175	4.0176	4.0176	4.0177	4.0177	4.0177	4.0178	4.0178
53 40	4.0179	4.0179	4.0180	4.0180	4.0180	4.0181	4.0181	4.0182	4.0182	4.0182
53 50	4.0183	4.0183	4.0184	4.0184	4.0185	4.0185	4.0185	4.0186	4.0186	4.0187
2 54 0	4.0187	4.0187	4.0188	4.0188	4.0189	4.0189	4.0190	4.0190	4.0190	4.0191
54 10	4.0191	4.0192	4.0192	4.0192	4.0193	4.0193	4.0194	4.0194	4.0194	4.0195
54 20	4.0195	4.0196	4.0196	4.0197	4.0197	4.0197	4.0198	4.0198	4.0199	4.0199
54 30	4.0199	4.0200	4.0200	4.0201	4.0201	4.0202	4.0202	4.0202	4.0203	4.0203
54 40	4.0204	4.0204	4.0204	4.0205	4.0205	4.0206	4.0206	4.0207	4.0207	4.0207
54 50	4.0208	4.0208	4.0209	4.0209	4.0209	4.0210	4.0210	4.0211	4.0211	4.0211
2 55 0	4.0212	4.0212	4.0213	4.0213	4.0214	4.0214	4.0214	4.0215	4.0215	4.0216
55 10	4.0216	4.0216	4.0217	4.0217	4.0218	4.0218	4.0219	4.0219	4.0219	4.0220
55 20	4.0220	4.0221	4.0221	4.0221	4.0222	4.0222	4.0223	4.0223	4.0223	4.0224
55 30	4.0224	4.0225	4.0225	4.0225	4.0226	4.0226	4.0227	4.0227	4.0228	4.0228
55 40	4.0228	4.0229	4.0229	4.0230	4.0230	4.0230	4.0231	4.0231	4.0232	4.0232
55 50	4.0233	4.0233	4.0233	4.0234	4.0234	4.0235	4.0235	4.0235	4.0236	4.0236
2 56 0	4.0237	4.0237	4.0237	4.0238	4.0238	4.0239	4.0239	4.0240	4.0240	4.0240
56 10	4.0241	4.0241	4.0242	4.0242	4.0242	4.0243	4.0243	4.0244	4.0244	4.0244
56 20	4.0245	4.0245	4.0246	4.0246	4.0246	4.0247	4.0247	4.0248	4.0248	4.0249
56 30	4.0249	4.0249	4.0250	4.0250	4.0251	4.0251	4.0251	4.0252	4.0252	4.0253
56 40	4.0253	4.0253	4.0254	4.0254	4.0255	4.0255	4.0256	4.0256	4.0256	4.0257
56 50	4.0257	4.0258	4.0258	4.0258	4.0259	4.0259	4.0260	4.0260	4.0260	4.0261
2 57 0	4.0261	4.0262	4.0262	4.0262	4.0263	4.0263	4.0264	4.0264	4.0265	4.0265
57 10	4.0265	4.0266	4.0266	4.0267	4.0267	4.0267	4.0268	4.0268	4.0269	4.0269
57 20	4.0269	4.0270	4.0270	4.0271	4.0271	4.0271	4.0272	4.0272	4.0273	4.0273
57 30	4.0273	4.0274	4.0274	4.0275	4.0275	4.0276	4.0276	4.0276	4.0277	4.0277
57 40	4.0278	4.0278	4.0278	4.0279	4.0279	4.0280	4.0280	4.0280	4.0281	4.0281
57 50	4.0282	4.0282	4.0282	4.0283	4.0283	4.0284	4.0284	4.0284	4.0285	4.0285
2 58 0	4.0286	4.0286	4.0287	4.0287	4.0287	4.0288	4.0288	4.0289	4.0289	4.0289
58 10	4.0290	4.0290	4.0291	4.0291	4.0291	4.0292	4.0292	4.0293	4.0293	4.0293
58 20	4.0294	4.0294	4.0295	4.0295	4.0295	4.0296	4.0296	4.0297	4.0297	4.0297
58 30	4.0298	4.0298	4.0299	4.0299	4.0300	4.0300	4.0300	4.0301	4.0301	4.0302
58 40	4.0302	4.0302	4.0303	4.0303	4.0304	4.0304	4.0304	4.0305	4.0305	4.0306
58 50	4.0306	4.0306	4.0307	4.0307	4.0308	4.0308	4.0308	4.0309	4.0309	4.0310
2 59 0	4.0310	4.0310	4.0311	4.0311	4.0312	4.0312	4.0312	4.0313	4.0313	4.0314
59 10	4.0314	4.0314	4.0315	4.0315	4.0316	4.0316	4.0317	4.0317	4.0317	4.0318
59 20	4.0318	4.0319	4.0319	4.0319	4.0320	4.0320	4.0321	4.0321	4.0321	4.0322
59 30	4.0322	4.0323	4.0323	4.0323	4.0324	4.0324	4.0325	4.0325	4.0325	4.0326
59 40	4.0326	4.0327	4.0327	4.0327	4.0328	4.0328	4.0329	4.0329	4.0329	4.0330
59 50	4.0330	4.0331	4.0331	4.0331	4.0332	4.0332	4.0333	4.0333	4.0333	4.0334

TABLE X.

TABLE SHOWING THE CORRECTION REQUIRED, ON ACCOUNT OF
SECOND DIFFERENCES OF THE MOON'S MOTION, IN FINDING
THE GREENWICH TIME CORRESPONDING TO A
CORRECTED LUNAR DISTANCE.

Approximate Interval.		Difference of the Proportional Logarithms in the Ephemeris.																											
		2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52		
h m	h m	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s		
0 0	3 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
0 10	2 50	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3		
0 20	2 40	0	1	1	1	1	2	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6		
0 30	2 30	0	1	1	2	2	2	2	3	3	3	4	4	5	5	5	6	6	6	7	7	7	8	8	8	9	9		
0 40	2 20	0	1	1	2	2	3	3	3	4	4	5	5	6	6	6	7	7	8	8	9	9	10	10	10	11	11		
0 50	2 10	1	1	2	2	3	3	4	4	5	5	6	6	6	7	7	8	8	9	9	10	10	11	12	12	13	13		
1 0	2 0	1	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	9	10	10	11	12	12	13	13	14	14		
1 10	1 50	1	1	2	2	3	4	4	5	5	6	6	7	8	8	9	9	10	11	11	12	12	13	14	14	15	15		
1 20	1 40	1	1	2	3	3	4	4	5	6	6	7	7	8	9	9	10	10	11	12	12	13	14	14	15	16	16		
1 30	1 30	1	1	2	3	3	4	4	5	6	6	7	8	8	9	9	10	11	11	12	12	13	14	14	15	16	16		

		Difference of the Proportional Logarithms in the Ephemeris.																								
		54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102
h m	h m	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s
0 0	3 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0 10	2 50	4	4	4	4	4	4	4	4	5	5	5	5	5	5	6	6	6	6	6	6	6	6	7	7	7
0 20	2 40	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12	13	13
0 30	2 30	9	10	10	10	11	11	12	12	12	13	13	13	14	14	14	14	15	15	16	16	16	17	17	17	18
0 40	2 20	12	12	13	13	13	14	14	15	15	16	16	16	17	17	18	18	19	19	19	20	20	21	21	22	22
0 50	2 10	14	14	15	15	16	16	16	17	17	18	19	19	20	20	21	21	22	22	22	23	23	24	24	25	26
1 0	2 0	15	16	16	17	17	18	18	19	19	20	21	21	22	22	23	23	24	24	25	25	26	27	27	28	28
1 10	1 50	16	17	17	18	18	19	19	20	21	21	22	22	23	24	24	25	25	26	27	27	28	28	29	30	30
1 20	1 40	17	17	18	19	19	20	20	21	21	22	23	23	24	25	25	26	26	27	28	28	29	29	30	31	31
1 30	1 30	17	18	18	19	19	20	21	21	22	23	23	24	24	25	25	26	27	27	28	29	29	30	31	31	32

		Difference of the Proportional Logarithms in the Ephemeris.																
		104	106	108	110	112	114	116	118	120	122	124	126	128	130	132	134	136
h m	h m	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s
0 0	3 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0 10	2 50	7	7	7	7	7	7	8	8	8	8	8	8	8	8	8	9	9
0 20	2 40	13	13	13	14	14	14	14	15	15	15	15	15	15	16	16	16	17
0 30	2 30	18	18	19	19	19	20	20	20	21	21	21	22	22	22	23	23	24
0 40	2 20	22	23	23	24	24	25	25	25	26	26	27	27	28	28	29	29	30
0 50	2 10	26	26	27	27	28	29	29	29	30	30	31	31	32	32	33	33	34
1 0	2 0	29	29	30	30	31	31	32	33	33	34	34	35	35	36	37	37	38
1 10	1 50	31	31	32	32	33	34	34	35	35	36	37	37	38	38	39	40	40
1 20	1 40	32	33	33	34	34	35	35	36	37	38	38	39	39	40	41	41	42
1 30	1 30	32	33	34	34	35	35	36	36	37	38	39	39	40	40	41	42	42

The Correction is to be *added* to the approximate Greenwich Time when the Proportional Logarithms in the Ephemeris are *decreasing*, and *subtracted* when they are *increasing*.

TABLE XI.

LOG. N FOR DISTANCES FROM THE SUN.

1855.	0 ^h .	3 ^h .	6 ^h .	9 ^h .	12 ^h .	15 ^h .	18 ^h .	21 ^h .	1855.	0 ^h .	3 ^h .	6 ^h .	9 ^h .	12 ^h .	15 ^h .	18 ^h .	21 ^h .
Jan. 7	−0.76	.78	.79	.80	.81	.82	.83	.84	Apr. 10	+0.66	.69	.72	.74	.77	.79	.81	.83
8	0.85	.86	.87	.87	.88	.89	.89	.90	11	0.85	0.86	0.88	0.89	0.91	0.92	0.93	0.95
9	0.90	.91	.91	.91	.92	.92	.92	.92	12	0.96	0.97	0.98	0.99	1.00	1.01	1.02	1.02
10	0.92	.92	.92	.92	.92	.92	.92	.92	13	+1.03	1.04	1.04	1.05	1.06	1.06	1.07	1.07
11	0.92	.91	.91	.91	.90	.90	.89	.89	18	−0.80	0.78	0.77	0.76	0.75	0.73	0.71	0.69
12	−0.88	.87	.86	.85	.84	.83	.82	.81	19	−0.67	.65	.63	.60	.58	.55	.52	.48
13	0.80	.78	.77	.75	.73	.71	.69	.66	20	−0.46	.41	.36	.31	.25	.18	.10	.00
14	0.63	.60	.56	.52	.48	.42	.36	.28	22	+0.12	.20	.26	.32	.37	.41	.45	.49
20	0.71	.74	.76	.79	.81	.83	.84	.85	23	0.52	.55	.58	.60	.63	.65	.67	.69
21	0.87	.88	.89	.89	.90	.91	.91	.92	24	0.71	.73	.75	.76	.78	.79	.80	.82
22	−0.92	.93	.93	.93	.93	.93	.93	.93	25	+0.83	.84	.85	.86	.87	.88	.89	.90
23	0.93	.93	.93	.92	.92	.91	.91	.90	26	0.91	.92	.93	.93	.94	.95	0.95	0.96
24	0.90	.89	.89	.88	.87	.86	.85	.84	27	0.97	0.97	0.98	.98	.99	.99	0.99	1.00
25	0.83	.82	.81	.80	.78	.77	.75	.74	May 6	9.77	9.96	0.10	.20	.28	.35	0.40	0.46
26	0.72	.70	.68	.66	.64	.61	.59	.56	7	0.50	0.54	0.58	.61	.64	.67	.70	.72
27	−0.53	.49	.45	.41	.37	.31	.25	.18	8	+0.75	.77	.79	.80	.82	.84	.85	.87
Feb. 6	0.88	.88	.88	.89	.89	.89	.89	.89	9	0.88	.89	.90	.92	.93	.94	.94	0.95
7	0.89	.89	.89	.89	.89	.88	.88	.88	10	0.96	0.97	0.97	0.98	0.99	0.99	0.99	1.00
8	0.87	.87	.86	.86	.85	.84	.83	.82	11	1.00	1.01	1.01	1.01	1.01	1.01	1.01	1.01
9	0.82	.80	.79	.78	.77	.75	.74	.72	12	1.01	1.01	1.01	1.01	1.01	1.00	1.00	1.00
10	−0.70	.68	.66	.64	.61	.58	.55	.52	13	+0.99	0.09	0.98	0.97	0.97	0.96	0.95	0.94
11	−0.48	.43	.38	.32	.25	.16	.05	9.89	18	−0.46	.41	.35	.29	.22	.13	0.03	9.89
13	+0.43	.49	.55	.60	.64	.69	.73	.76	20	+0.23	.29	.34	.39	.43	.47	0.51	0.54
14	+0.80	.83	.87	.90	.93	.96	.99	1.02	21	0.57	.59	.62	.64	.66	.68	.70	.72
18	−0.78	.80	.82	.84	.85	.86	.87	.88	22	0.73	.75	.76	.78	.79	.81	.82	.83
19	−0.89	.89	.90	.90	.90	.90	.90	.90	23	+0.84	.85	.86	.87	.88	.88	.89	.90
20	0.90	.89	.89	.89	.88	.88	.87	.86	24	0.91	.91	.92	.93	.93	.94	.94	.94
21	0.86	.85	.84	.83	.82	.81	.79	.78	25	0.95	.95	.96	.96	.96	.96	.96	.97
22	0.77	.75	.74	.72	.70	.69	.67	.64	26	0.97	.97	.97	.97	.97	.97	.97	.96
23	0.62	.60	.57	.54	.51	.48	.44	.40	27	0.96	.96	.96	.95	.95	.94	.94	.93
26	+0.30	.36	.41	.45	.49	.53	.56	.60	June 3	+0.05	.18	.28	.35	.42	.47	.52	.56
Mar. 8	−0.83	.82	.81	.80	.79	.78	.77	.76	4	0.60	.63	.66	.69	.72	.74	.76	.78
9	0.74	.73	.71	.70	.68	.66	.64	.60	5	0.80	.82	.83	.85	.86	.87	.88	.89
10	−0.59	.56	.53	.49	.45	.41	.36	.30	6	0.90	.91	.92	.93	.94	.94	.95	.95
12	+0.91	.06	.17	.26	.34	.40	.46	.51	7	0.96	.96	.97	.97	.97	.97	.98	.98
13	+0.55	.59	.63	.67	.70	.73	.76	.78	8	+0.98	.98	.98	.98	.97	.97	.97	.97
14	0.81	0.83	0.85	0.87	0.89	0.91	0.93	0.95	9	0.96	.96	.95	.95	.94	.94	.93	.92
15	+0.97	0.99	1.00	1.02	1.03	1.05	1.06	1.08	10	0.91	.91	.90	.88	.87	.86	.85	.83
19	−0.78	0.80	0.82	0.84	0.84	0.85	0.85	0.86	11	0.82	.80	.78	.76	.73	.71	.68	.64
20	−0.86	.86	.85	.85	.84	.84	.83	.82	17	0.18	.26	.32	.38	.43	.47	.51	.54
21	−0.82	.81	.80	.78	.77	.76	.74	.73	18	+0.57	.60	.63	.65	.67	.69	.71	.73
22	0.71	.69	.67	.65	.63	.61	.58	.55	19	0.74	.76	.77	.79	.80	.81	.82	.83
23	−0.53	.49	.46	.42	.38	.33	.27	.21	20	0.84	.85	.86	.87	.87	.88	.89	.89
25	+0.84	.98	.08	.16	.23	.29	.35	.39	21	0.90	.90	.91	.91	.92	.92	.93	.93
26	0.44	.48	.51	.54	.57	.60	.63	.65	22	0.93	.93	.92	.94	.94	.94	.94	.94
27	+0.67	.69	.71	.73	.75	.77	.79	.80	23	+0.94	.94	.94	.93	.93	.93	.93	.92
28	+0.82	.83	.85	.86	.87	.88	.90	.91	24	0.92	.91	.91	.90	.90	.89	.88	.88
Apr. 6	−0.67	.65	.63	.61	.58	.55	.52	.48	25	0.87	.86	.85	.83	.82	.81	.79	.78
7	−0.44	.40	.35	.29	.22	.13	.03	.88	July 3	0.82	.84	.85	.87	.88	.89	.90	.91
9	+0.31	.37	.43	.48	.52	.56	.60	.63	4	0.92	.92	.93	.93	.93	.94	.95	.95

TABLE XI.

LOG. N FOR DISTANCES FROM THE SUN.

1855.	0 ^h .	3 ^h .	6 ^h .	9 ^h .	12 ^h .	15 ^h .	18 ^h .	21 ^h .	1855.	0 ^h .	3 ^h .	6 ^h .	9 ^h .	12 ^h .	15 ^h .	18 ^h .	21 ^h .		
July	5	+0.95	.95	.96	.96	.96	.95	.95	Oct.	3	—0.40	.44	.48	.52	.55	.58	.61	.63	
	6	0.95	.95	.94	.94	.94	.93	.93		4	0.66	.68	.70	.72	.74	.76	.77	.79	
	7	0.91	.91	.90	.89	.88	.87	.86		5	0.80	.82	.83	.84	.86	.87	.88	.89	
	8	0.84	.83	.81	.80	.78	.76	.75		6	0.90	.91	.92	0.93	0.94	0.95	0.96	0.96	
	9	0.70	.68	.66	.63	.60	0.57	0.53		7	—0.97	.98	.98	0.99	1.00	1.00	1.01	1.02	
	10	+0.44	.39	.38	.25	.16	0.04	9.86		13	+0.84	.83	.82	0.81	0.80	0.78	0.77	0.76	
	16	0.47	.52	.56	.60	.63	0.66	0.68		14	0.74	.72	.71	.69	.67	.64	.62	.59	
	17	0.72	.74	.76	.77	.79	.80	.81		15	+0.56	.53	.50	.46	.42	.37	.31	.25	
	18	0.83	.84	.85	.86	.86	.87	.88		17	—9.98	.10	.20	.28	.34	.40	.45	.50	
	19	0.89	.89	.90	.90	.90	.91	.91		18	0.54	.58	.61	.64	.67	.70	.73	.75	
	20	+0.91	.91	.91	.91	.91	.91	.91		19	—0.77	.79	.81	.83	.85	.86	.88	.89	
	21	0.91	.91	.90	.90	.90	.89	.89		20	0.91	.92	.93	.94	.96	.97	.98	.99	
	22	0.88	.87	.86	.85	.85	.84	.83		30	9.99	.10	.18	.25	.31	.36	.41	.45	
	23	0.80	.79	.78	.76	.75	.73	.71		31	0.49	.52	.55	.58	.61	.63	.65	.68	
	24	0.67	.64	.62	.59	.55	.52	.47		Nov.	1	0.70	.72	.73	.75	.77	.78	.79	.81
Aug.	1	+0.91	.92	.92	.93	.93	.93	.94		2	—0.82	.83	.84	.85	.86	.87	.88	.89	
	2	0.94	.94	.94	.94	.93	.93	.93		3	0.90	.91	.91	.92	.93	.93	.94	.94	
	3	0.92	.91	.91	.90	.90	.89	.88		4	0.95	.95	.96	.96	.96	.97	.97	.97	
	4	0.86	.85	.86	.83	.82	.80	.79		5	0.98	.98	.98	.98	.98	.98	.98	.98	
	5	0.76	.74	.72	.70	.68	.66	.63		6	—0.98	.98	.98	.98	.98	.97	.97	.97	
	6	+0.58	.55	.51	.47	.43	.38	.83		12	+0.53	.48	.43	.37	.31	.23	.14	.02	
	8	—9.93	.07	.17	.26	.33	.39	.45		14	—0.28	.35	.41	.46	.50	.54	.58	.61	
	9	—0.54	.58	.62	.66	.69	.72	.75		15	0.64	.67	.76	.72	.74	.77	.79	.80	
	15	+0.79	.81	.82	.83	.84	.85	.86		16	0.82	.84	.85	.87	.88	.89	.90	.91	
	16	0.87	.87	.88	.88	.88	.89	.89		17	0.92	.93	.94	.95	.96	0.96	0.97	0.97	
	17	+0.89	.89	.89	.89	.89	.88	.88		18	—0.98	0.98	0.99	0.99	0.99	1.00	1.00	1.00	
	18	0.88	.87	.87	.86	.86	.85	.84		19	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	
	19	0.83	.82	.81	.80	.79	.78	.76		27	0.06	0.16	0.24	0.31	0.36	0.41	.45	.49	
	20	0.73	.72	.70	.68	.66	.64	.61		28	0.53	.56	.59	.62	.64	.66	.68	.70	
	21	+0.55	.52	.48	.44	.40	.34	.28		29	0.72	.73	.75	.76	.78	.79	.80	.82	
	23	—0.17	.27	.35	.42	.48	.53	.58		30	—0.83	.84	.85	.86	.86	.87	.88	.89	
	30	+0.92	.92	.92	.91	.91	.91	.90		Dec.	1	0.89	.90	.91	.91	.92	.92	.93	.93
	31	0.89	.88	.87	.87	.86	.85	.84		2	0.93	.94	.94	.94	.94	.95	.95	.95	
Sept.	1	0.81	.70	.78	.77	.75	.74	.72		3	0.95	.95	.95	.95	.95	.95	.94	.94	
	2	0.67	.65	.63	.60	.57	.54	.51		4	0.94	.94	.93	.93	.93	.92	.92	.91	
	3	+0.43	.38	.33	.27	.20	.12	.02		5	—0.90	.90	.89	.88	.87	.86	.85	.84	
	5	—0.24	.31	.36	.41	.46	.50	.53		6	0.82	.81	.79	.77	.75	.73	.70	.67	
	6	0.60	.63	.65	.68	.70	.73	.75		12	0.38	.44	.49	.54	.58	.62	.65	.68	
	7	—0.79	.81	.83	.84	.86	.88	.89		13	0.71	.73	.75	.77	.79	.81	.83	.84	
	13	+0.83	.84	.85	.85	.86	.86	.86		14	0.86	.87	.88	.89	.90	.91	.92	.93	
	14	+0.87	.87	.87	.86	.86	.86	.86		15	—0.93	.94	.95	.95	.96	.96	.96	.97	
	15	0.85	.84	.83	.83	.82	.81	.80		16	0.97	.97	.97	.97	.97	.97	.97	.97	
	16	0.78	.77	.75	.74	.72	.71	.69		17	0.97	.96	.96	.96	.95	.95	.94	.94	
	17	0.65	.63	.60	.58	.55	0.52	0.48		18	0.93	.92	.91	.90	.89	.88	.87	.86	
	18	+0.40	.35	.29	.22	.14	0.03	9.89		27	0.72	.73	.75	.76	.78	.79	.80	.81	
	20	—0.39	.44	.49	.54	.58	0.62	0.65		28	—0.83	.84	.84	.85	.86	.87	.88	.88	
	21	—0.71	.74	.77	.79	.82	.84	.86		29	0.89	.89	.90	.90	.91	.91	.91	.92	
	29	+0.77	.75	.74	.72	.70	.68	.65		30	0.92	.92	.92	.92	.93	.93	.93	.93	
	30	+0.60	0.57	0.54	0.50	.46	.42	.37		31	—0.93	.92	.92	.92	.92	.92	.91	.91	
Oct.	2	—9.58	9.81	9.97	0.08	.16	.24	.30											

TABLE XII.

For finding the value of N for correcting lunar distances for the compression of the earth.

TABLE XII. A. giving 1st Part of N .

App. Dist.	D's Declination.										
	0	3	6	9	12	15	18	21	24	27	30
20	—0	3	6	10	13	16	19	22	25	28	31
22	0	3	6	9	12	14	17	20	23	25	28
24	0	3	5	8	11	13	16	18	21	23	25
26	0	2	5	7	10	12	14	17	19	21	23
28	0	2	4	7	9	11	13	15	17	19	21
30	—0	2	4	6	8	10	12	14	16	18	20
32	0	2	4	6	8	9	11	13	15	16	18
34	0	2	4	5	7	9	10	12	14	15	17
36	0	2	3	5	7	8	10	11	13	14	16
38	0	2	3	5	6	8	9	10	12	13	14
40	—0	1	3	4	6	7	8	10	11	12	13
42	0	1	3	4	5	7	8	9	10	11	13
44	0	1	2	4	5	6	7	8	10	11	12
46	0	1	2	3	5	6	7	8	9	10	11
48	0	1	2	3	4	5	6	7	8	9	10
50	—0	1	2	3	4	5	6	7	8	9	10
52	0	1	2	3	4	5	5	6	7	8	9
54	0	1	2	3	3	4	5	6	7	7	8
56	0	1	2	2	3	4	5	5	6	7	8
58	0	1	1	2	3	4	4	5	6	6	7
60	—0	1	1	2	3	3	4	5	5	6	7
62	0	1	1	2	3	3	4	4	5	5	6
64	0	1	1	2	2	3	3	4	4	5	6
66	0	1	1	2	2	3	3	4	4	5	5
68	0	0	1	1	2	2	3	3	4	4	5
70	—0	0	1	1	2	2	3	3	3	4	4
72	0	0	1	1	2	2	2	3	3	3	4
74	0	0	1	1	1	2	2	2	3	3	3
76	0	0	1	1	1	1	2	2	2	3	3
78	0	0	0	1	1	1	1	2	2	2	2
80	—0	0	0	1	1	1	1	1	2	2	2
82	0	0	0	0	1	1	1	1	1	1	2
84	0	0	0	0	0	1	1	1	1	1	1
86	0	0	0	0	0	0	0	1	1	1	1
88	0	0	0	0	0	0	0	0	0	0	0
90	—0	0	0	0	0	0	0	0	0	0	0
92	+0	0	0	0	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0	1	1	1	1
96	0	0	0	0	0	1	1	1	1	1	1
98	0	0	0	0	0	1	1	1	1	1	2
100	+0	0	0	1	1	1	1	1	2	2	2
102	0	0	0	1	1	1	1	2	2	2	2
104	0	0	1	1	1	1	2	2	2	3	3
106	0	0	1	1	1	2	2	2	3	3	3
108	0	0	1	1	2	2	2	3	3	3	4
110	+0	0	1	1	2	2	3	3	3	4	4
112	0	0	1	1	2	2	3	3	4	4	5
114	0	1	1	2	2	3	3	4	4	5	5
116	0	1	1	2	2	3	3	4	4	5	6
118	0	1	1	2	3	3	4	4	5	5	6
120	+0	1	1	2	3	3	4	5	5	6	7
122	0	1	1	2	3	4	4	5	6	6	7
124	0	1	2	2	3	4	5	5	6	7	8
126	0	1	2	3	3	4	5	6	7	7	8
128	0	1	2	3	4	5	5	6	7	8	9
130	+0	1	2	3	4	5	6	7	8	9	10

TABLE XII. B. giving 2d Part of N .

App. Dist.	*s Declination.										
	0	3	6	9	12	15	18	21	24	27	30
20	+0	3	7	10	14	17	20	24	27	30	33
22	0	3	6	9	13	16	19	22	25	27	30
24	0	3	6	9	12	14	17	20	23	25	28
26	0	3	5	8	11	13	16	18	21	23	26
28	0	3	5	8	10	12	15	17	20	22	24
30	+0	2	5	7	9	12	14	16	18	21	23
32	0	2	4	7	9	11	13	15	17	19	21
34	0	2	4	6	8	11	13	15	16	18	20
36	0	2	4	6	8	10	12	14	16	17	19
38	0	2	4	6	8	10	11	13	15	17	18
40	+0	2	4	6	7	9	11	13	14	16	18
42	0	2	4	5	7	9	10	12	14	15	17
44	0	2	3	5	7	8	10	12	13	15	16
46	0	2	3	5	6	8	10	11	13	14	16
48	0	2	3	5	6	8	9	11	12	14	15
50	+0	2	3	5	6	8	9	11	12	13	15
52	0	2	3	4	6	7	9	10	12	13	14
54	0	1	3	4	6	7	9	10	11	13	14
56	0	1	3	4	6	7	8	10	11	12	14
58	0	1	3	4	6	7	8	10	11	12	13
60	+0	1	3	4	5	7	8	9	11	12	13
62	0	1	3	4	5	7	8	9	10	12	13
64	0	1	3	4	5	7	8	9	10	11	13
66	0	1	3	4	5	6	8	9	10	11	12
68	0	1	3	4	5	6	8	9	10	11	12
70	+0	1	3	4	5	6	7	9	10	11	12
72	0	1	2	4	5	6	7	9	10	11	12
74	0	1	2	4	5	6	7	8	10	11	12
76	0	1	2	4	5	6	7	8	9	11	12
78	0	1	2	4	5	6	7	8	9	11	12
80	+0	1	2	4	5	6	7	8	9	10	11
82	0	1	2	4	5	6	7	8	9	10	11
84	0	1	2	4	5	6	7	8	9	10	11
86	0	1	2	4	5	6	7	8	9	10	11
88	0	1	2	4	5	6	7	8	9	10	11
90	+0	1	2	4	5	6	7	8	9	10	11
92	0	1	2	4	5	6	7	8	9	10	11
94	0	1	2	4	5	6	7	8	9	10	11
96	0	1	2	4	5	6	7	8	9	10	11
98	0	1	2	4	5	6	7	8	9	10	11
100	+0	1	2	4	5	6	7	8	9	10	11
102	0	1	2	4	5	6	7	8	9	11	12
104	0	1	2	4	5	6	7	8	9	11	12
106	0	1	2	4	5	6	7	8	10	11	12
108	0	1	2	4	5	6	7	9	10	11	12
110	+0	1	3	4	5	6	7	9	10	11	12
112	0	1	3	4	5	6	8	9	10	11	12
114	0	1	3	4	5	6	8	9	10	11	12
116	0	1	3	4	5	7	8	9	10	11	13
118	0	1	3	4	5	7	8	9	10	12	13
120	+0	1	3	4	5	7	8	9	11	12	13
122	0	1	3	4	6	7	8	10	11	12	13
124	0	1	3	4	6	7	8	10	11	12	14
126	0	1	3	4	6	7	9	10	11	13	14
128	0	2	3	4	6	7	9	10	12	13	14
130	+0	2	3	5	6	8	9	11	12	13	15

The signs in the 0° column apply to all the numbers in the same line, and are to be used when the declination is North. When the declination is South, change the sign + to — and — to +.

IMPROVED METHOD
OF FINDING THE
ERROR AND RATE OF A CHRONOMETER
BY EQUAL ALTITUDES.

FROM THE APPENDIX TO THE AMERICAN EPHEMERIS AND NAUTICAL
ALMANAC FOR 1856.

METHOD

OF FINDING THE

ERROR AND RATE OF A CHRONOMETER BY EQUAL ALTITUDES.

To regulate a chronometer to Greenwich time, we must determine its error and rate at a place whose longitude is well known. The most accurate method of doing this is by observing the transit of the sun or a star over the meridian. For the navigator, the most simple and accurate substitute for the meridian observation is that of equal altitudes of the same object on each side of the meridian. In the case of a star, the mean of the two chronometer times corresponding to the equal altitudes is the chronometer time of transit; but in the case of the sun, the mean of these times differs somewhat from the time of transit, since, in consequence of the change of the sun's declination between the observations, the equal altitudes do not occur at equal intervals before and after the transit.

The small correction necessary, when the sun is observed, to reduce the mean of the times to the time of transit, is called the *Equation of Equal Altitudes*.

The method of computing this equation given below is based upon that first given by GAUSS (*Monatliche Correspondenz*, Vol. XXIII.). We do not, however, follow him in using the double daily change of declination, or difference between the sun's declination on the noon preceding and the noon following that of the observation; but prefer to use the hourly difference, because this may be obtained directly from the American Ephemeris, and is at the same time even more accurate. We also extend our table so as to meet the case where one altitude is taken in the afternoon and the corresponding equal altitude on the following morning; in which case, the equation is computed for apparent midnight.*

* It should be observed, as a caution to navigators, that the rule for computing the equation for midnight is sometimes inaccurately, or incompletely, stated in works on navigation or astronomy. The rule in LIEUT. RAPER'S *Practice of Navigation* is wholly erroneous. GALBRAITH'S rule (*Mathematical and Astronomical Tables*) is incomplete, in not noticing the case where the elapsed time is less than 12^h. His rule for computing the equation for noon is similarly defective, in not noticing the case where the elapsed time is greater than 12^h. In Professor INMAN'S rule there is a slight inaccuracy introduced, by taking the equation of time for mean, instead of apparent noon or midnight; and in all the books,

EQUAL ALTITUDES.

I. EQUAL ALTITUDES OF THE SUN, MORNING AND EVENING.

THE OBSERVATION.

On shore, at a place whose longitude is *accurately* known, and whose latitude is *approximately* known, observe with an artificial horizon the same altitude both in the morning and in the afternoon, as near the prime vertical as convenient after the altitude is more than 10° , noting the times by the chronometer. In low latitudes, however, the method of equal altitudes will often give very accurate results, even when the observations are quite near to the meridian. In general, a sufficiently accurate result may be obtained if the observations are taken when the sun's change of altitude is not less than $10''$ in $0^\circ.5$, or when the change in the double altitude taken with the artificial horizon is not less than $20''$ in $0^\circ.5$.

It is most convenient, as well as conducive to accuracy, to take the observation in the following manner. In the morning, bring the lower limb of the sun, reflected from the sextant-mirrors, and the upper limb of that reflected from the mercury, into approximate contact; move the 0 of the vernier forward (say from $10'$ to $20'$), and set it on a division of the limb; the images will be *overlapped* and will be *separating*; wait for the instant of contact; note it by chronometer, and immediately set the vernier on the next division of the limb, that is, $10'$ in advance; note the instant of contact again, and proceed in the same manner for as many observations as are thought necessary. If the sun rises too rapidly, let the intervals on the limb be $20'$. Find (roughly) the time when the sun will be at the same altitude in the afternoon, and just before that time set the vernier on the last altitude noted in the morning (of course using the same sextant); the images of the sun will be *separated*, but will be *approaching*; wait for the instant of contact; note it by chronometer; set the vernier *back* to the next division of the limb ($10'$ or $20'$, as the case may be); note the contact again, and so proceed till all the A. M. altitudes have been again noted as P. M. altitudes.

THE COMPUTATION.

Take the mean of the A. M. times and call it the *A. M. Chronometer Time*. The mean of the P. M. times call the *P. M. Chronometer Time*. If, instead of noting the times by the chronometer, a watch is used (compared with the chronometer both before and after each observation), it will generally be found necessary to make an allowance for its gain or loss on the chronometer, so as to obtain the exact difference between the watch and chronometer at the instant of observation. This difference being applied to the mean of the watch times, we have the mean chronometer time the same as would have been found by employing the chronometer directly.

the methods given of taking out the sun's change of declination, whether for 48^h or for 24^h , are not as accurate as they should be.

A perfectly accurate rule, with a special table, for the midnight correction, is given in SCHUMACHER'S *Hülftafeln* (Ed. by WARNSTORFF). It requires, however, one logarithm more than our method in the text, and is otherwise not so simple.

EQUAL ALTITUDES.

The half sum of the A. M. and P. M. Chronometer Times is the *Middle Chronometer Time*, their difference is the *Elapsed Time*; observing that when the A. M. time is before 12^h. by chronometer, while the P. M. time is after 12^h., the latter must be supposed to be increased by 12^h. in finding this half sum and difference.

Take from the Nautical Almanac the sun's declination, the hourly difference of declination, and the equation of time, reducing each to the instant of local apparent noon by applying the changes for the longitude.

Mark *north* latitude and *north* declination +

“ *south* latitude and *south* declination —

“ hourly diff. of decl. when *towards north* +

“ hourly diff. of decl. when *towards south* —.

Enter Table I. with the elapsed time, and take out log. A and log. B, prefixing to each its proper sign given in the table at the head of the page.

To log. A add the log. of the hourly diff., Table II., and the log. tangent of the latitude (Bowditch, Table XXVII.). Prefix to each log. the sign of the quantity it represents and to their sum the sign which results from the algebraic combination of the three signs.* This sum is the log. (Table II.) of the number of seconds of time in the *first part* of equation of equal altitudes, to be marked + or — like its log.

To log. B. add the log. of the hourly diff. and the log. tangent of the declination, marking the signs as before. The sum is the log. of the *second part* of the equation of equal altitudes, to be marked + or — like its log.

Apply the two parts of the equation, according to their signs, to the *Middle Chronometer Time*; the result is the *Chronometer Time of Apparent Noon*.

To this apply the equation of time (adding, when the equation of time is additive to mean time, otherwise subtracting); the result is the *Chronometer Time of Mean Noon*, which, if the chronometer is regulated to local time, will be 12^h. 0^m. 0^s. when the chronometer is right; more than 12^h. when fast, less than 12^h. when slow.

If the chronometer is regulated to Greenwich time, apply the longitude (in time) to the chronometer time of mean noon (subtracting in west, adding in east); the result will be more or less than 12^h., according as the chronometer is fast or slow.

Repeat this process on a subsequent day. The difference between the chronometer errors on the two days, divided by the number of days in the interval, is the *daily rate* of the chronometer, *gaining* or *losing* according as the chronometer goes too fast or too slow.

EXAMPLE 1.

May 3d, 1856. At the United States Naval Academy, Lat. 38° 59' N., Long. 5^h. 5^m. 55^s.1 W., suppose the following observations of equal altitudes to be taken with an artificial horizon. Required the error of the chronometer on Greenwich time at noon of that day?

* The algebraic rule being, that, when there is an *odd* number of factors with the sign minus, the result must have the sign minus, otherwise the sign plus. In the present application of this rule, when there is either *one* or *three* of the logs. marked —, their sum must be marked —; otherwise +.

EQUAL ALTITUDES.

A. M. Comparisons.			P. M. Comparisons.		
Chronom.	h. m. s.		Chronom.	h. m. s.	
Watch	12 52 0.0		Watch	8 37 0.0	
Diff.	7 45 8.0		Diff.	3 30 31.3	
	5 6 52.0			5 6 28.7	
Chronom.	1 20 0.0		Chronom.	9 11 0.0	
Watch	8 13 9.5		Watch	4 4 33.5	
Diff.	5 6 50.5		Diff.	5 6 26.5	
Watch A. M.			Watch P. M.		
	h. m. s.			h. m. s.	
	8 2 9.			3 52 10.7	
	8 2 35.5			3 51 44.0	
	8 3 0.5			3 51 18.5	
Mean	8 2 35.0		Mean	3 51 44.4	
Comparison	5 6 51.1		Comparison	5 6 27.3	
A. M. Chro. Time	1 9 26.1		P. M. Chro. Time	8 58 11.7	
P. M. Chro. Time	8 58 11.7		A. M. Chro. Time	1 9 26.1	
	2)10 7 37.8		Elapsed Time	7 48 45.6	
Middle Chro. T.	5 3 48.9				
Equat. of Eq. Alts.	-8.8				
Chro. T. App. N.	5 3 40.1				
Equat. of Time	+3 19.4				
Chro. T. Mean N.	5 6 59.5				
Longitude	5 5 55.1 W.				
Chro. fast	1 4.4				
2 ☉ Art. Hor.					
	65 50				
	66 0				
	66 10				
	m. s.	s.			
(Eq. T.)	-3 18.11	0.258			
	1.32	5.1			
Eq. T.	-3 19.43	1.32			
(D.)	+15 48 50.5	(H. D.)	+43.82	Decrease in	24.0 = 0.66
	3 42.8		-0.14	Decrease in	5.1 = 0.14
D.	+15 52 33.3	H. D.	+43.68		
			5.1		
			222.8		
	log. A. Tab. I.	-9.4846	log. B. Tab. I.	+9.2011	
	H. D. +43' 68 log. Tab. II.	+1.6403		+1.6403	
	Lat. +38° 59' log. tan.	+9.9081	D. +15° 53' log. tan.	+9.4542	
	1st Pt. Eq. -10°.79 log.	-1.0330	2d Pt. Eq. +1°.98 log.	+0.2956	

By similar observations on May 15th, suppose the chronometer is found to be fast 12".5; we have

	m. s.
May 3d, fast	1 4.4
May 15th, fast	12.5
Loses in 12 days	51.9
Daily rate	4.33 losing.

II. EQUAL ALTITUDES OF THE SUN, EVENING AND MORNING.

THE OBSERVATION.

Take a set of altitudes, in the manner already explained, in the afternoon of one day, and the same altitudes in reverse order on the morning of the next, noting the times by the chronometer, or by a watch compared with it.

THE COMPUTATION.

The half sum of the P. M. and A. M. Chronometer Times is the *Middle Chronometer Time*; their difference is the *Elapsed Time*; observing that when the P. M. time is before 12^h by chronometer, while the A. M. time is after 12^h, the latter must be supposed to be increased by 12^h in finding this half sum and this difference.

Take from the Nautical Almanac the sun's declination, the hourly difference of declination, and the equation of time, reducing them each to the instant of local *apparent midnight*.

EQUAL ALTITUDES.

Mark the sign of each quantity as before, and compute the two parts of the equation of equal altitudes precisely as in the preceding case, observing to mark the signs of log. A and log. B as given in the table for midnight.

Apply the two parts of the equation to the middle chronometer time, according to their signs; the result is the *Chronometer Time of Apparent Midnight*.

To this apply the equation of time (adding, when the equation of time is additive to mean time, otherwise subtracting); the result is the *Chronometer Time of Mean Midnight*, which, if the chronometer is regulated to local time, will be $12^h 0^m 0^s$ when the chronometer is right; more than 12^h when fast; less than 12^h when slow.

If the chronometer is regulated to Greenwich time, apply the longitude, in time, to the chronometer time of mean midnight (subtracting in west, adding in east); the result will be more or less than 12^h (or 24^h) according as the chronometer is fast or slow.

A repetition of this process at a subsequent day will give another error, whence the rate will be found as before. Or the rate may be found by comparing the results of an A. M. — P. M., and a P. M. — A. M. observation, remembering that the interval elapsed between two such observations is equal to the difference between the two dates *plus* or *minus* half a day.

EXAMPLE 2.

May 3d, 1856, Lat. $43^\circ 21' S.$, Long. $9^h 50^m 8^s E.$, suppose the altitude of the sun to be observed in the afternoon and the same altitude again on the morning of the 4th, as below. Required the error of the chronometer on Greenwich time at midnight of the 3d?

Chronom., P. M.
 $6^h 54^m 10^s.3$

2 ☉ Art. Hor.
 $38^\circ 0'$

Chronom., A. M.
 $9^h 9^m 17^s.5$

The A. M. time must be called $21^h 9^m 17^s.5$. The Greenwich time of midnight for which the declination, &c. must be found, is May $3^d 2^h 9^m 52^s$. ($= 3^d 2^h.16.$).

	h.	m.	s.
P. M. Chro. T.	6	54	10.3
A. M. Chro. T.	21	9	17.5
	2)28	3	27.8
Middle Chro. T.	14	1	43.9
Eq. of Eq. Alts.			-22.3
Chro. T. App. Midn.	14	1	21.6
Eq. of Time			+3 18.7
Chro. T. M'n Midn.	14	4	40.3
Longitude	9	50	8.0 E.
	23	54	48.3
	24	0	0.0
Chronom. <i>slow</i>		5	11.7

(Eq. T.)	-3	18.11	0.258
		0.56	2.15
Eq. T.	-3	18.67	0.56
(D.)	+15	48 50.5	
		1 34.1	
D.	+15	50 24.6	
(H. D.)	+43.82		
		-0.06	
H. D.	+43.76		
		2.15	
		94.1	

	h.	m.	s.
A. M. Chro. T.	21	9	17.5
P. M. Chro. T.	6	54	10.3
Elapsed T.	14	15	7.2

log. A. Tab. I.	+9.6958	log. B. Tab. I.	-9.1586
H. D. +43°.76	log. Tab. II.	+1.6411	
Lat. -43° 21'	log. tan.	-9.9750	D +15° 50'
1st Pt. Eq. -20°.51	log.	-1.3119	2d Pt. Eq. -1°.79
			log. -0.2524

By an A. M. — P. M. observation on May 20th, suppose this chronometer is found to be slow $8^m 14^s.6$; we have

d.	h.	m.	s.
May 3	12	slow	5 11.7
May 20	0	slow	8 14.6
Loses in 16d.5			3 2.9
Daily rate			11.09 losing.

EQUAL ALTITUDES.

III. EQUAL ALTITUDES OF A FIXED STAR.

THE OBSERVATION.

In selecting stars for this observation, it is to be observed that the nearer the zenith the star passes, the less may the elapsed time be; and when the star passes exactly through the zenith, the two altitudes may be taken within a few minutes of each other. But with the ordinary sextants, altitudes near 90° cannot be taken with the artificial horizon, as the double altitude is then nearly 180° . The prismatic sextants, or still better, the prismatic circles of Pistor and Martin, are adapted for measuring angles of all magnitudes up to 180° , and are therefore especially suitable for this observation.

Set the sextant and wait for the coincidences of the two images of the star, as in the case of the sun's limb, noting the times by chronometer or watch.

THE COMPUTATION.

Take the mean of the times before the meridian passage as the *A. M. Chronometer Time*, and the mean of those after the meridian passage as the *P. M. Chronometer Time*.

The mean of the A. M. and P. M. Chronometer Times is the *Chronometer Time of Star's Transit*. This time, if the chronometer is right, will agree with the true mean time of star's transit, which is to be computed as follows.

To the right ascension of the star apply the longitude of the place of observation (adding in west, subtracting in east); the result is the *Greenwich Sidereal Time of Star's Transit*, from which subtract the sidereal time at the *preceding* mean noon Greenwich (Nautical Almanac, page II. of the month); the remainder is the *Sidereal Interval* since mean noon. From Table IV. with the argument *Sidereal Interval*, take out the correction, which subtract from the sidereal interval; the remainder is the Greenwich Mean Time of the Star's Transit. The chronometer time will be more or less than this according as the chronometer is fast or slow.

If the chronometer is regulated to local time, apply the longitude to the Greenwich mean time of star's transit (subtracting in west, adding in east); the result is the *Local Mean Time of Star's Transit*, and the chronometer is fast or slow according as it shows more or less than this time.

EXAMPLE 3.

July 15th, 1856, at the Cape of Good Hope, Lat. $33^\circ 56' \text{ S.}$, Long. $1^{\text{h}} 13^{\text{m}} 56^{\text{s}} \text{ E.}$, observed equal altitudes of *Antares* as follows: —

EQUAL ALTITUDES.

Chronom. A. M.			2 Alt. Antares.		Chronom. P. M.				
	h.	m.	s.	°	'	h.	m.	s.	
	5	32	10.5	125	30	9	34	20.3	
	5	32	35.0		40	9	33	56.0	
	5	32	59.3		50	9	33	32.0	
A. M. Chro. T.	5	32	34.9			P. M. Chro. T.	9	33	56.1
P. M. Chro. T.	9	33	56.1						
	2)15	6	31.0	Antares R. A.			h.	m.	s.
Chro. T. * Transit	7	33	15.5	Longitude			16	20	37.58
Gr. T. * Transit	7	31	22.1	Gr. Sid. T.			15	6	41.58
Chro. fast		1	53.4	July 15, Gr. Sid. T. Mean Noon			7	34	5.25
				Sid. Interval			7	32	36.33
				Correction, Table IV.			—1	14.15	
				Gr. M. T. * Transit			7	31	22.18

IV. TO CORRECT FOR SMALL INEQUALITIES IN THE ALTITUDES

Although the sextant readings are the same at the A. M. and P. M. observations, it may happen that neither the true nor even the apparent altitudes are the same. 1st. Supposing the sextant to remain unchanged, the atmospheric refraction may be different at the two observations in consequence of changes in the density and temperature of the air as shown by the barometer and thermometer. In this case, the apparent altitudes are equal, but the true altitudes are not so. 2d. The sextant may be affected by changes of temperature, particularly in day observations in the sun, so as to make the sextant readings the same for apparent altitudes slightly different. I do not think these changes in the sextant are to be eliminated by determining the index error at each observation, as has been supposed by some, since it is quite possible that the expansion and contraction of the various parts might leave the index correction unchanged while it affected the readings of the altitudes, or the reverse. The only course appears to be to guard the instrument as much as possible from changes of temperature, exposing it to the sun's rays only during the few minutes required for each observation.

But the correction for changes of refraction may be satisfactorily made as follows. Note the barometer and thermometer both A. M. and P. M.; take out the corresponding refractions for each observation from Tables III., III. A., and III. B., and find the difference of these refractions. Also take the difference between any two sextant readings and the difference between the two corresponding chronometer times. Then the correction of either noon or midnight will be found by the following proportion. The difference of the sextant readings is to the difference of the refractions as the difference of the chronometer times is to the required correction.

Apply this correction to the Chronometer Time of Noon or Midnight (obtained by the preceding rules) as follows: *add* it when the A. M. refraction is the greater; *subtract* it when the P. M. refraction is the greater. The result is the true Chronometer Time of Noon or Midnight.

EXAMPLE. — Suppose, in Example 1, we have in the morning, Barometer 30 inches, Thermometer 55°; in the afternoon, Barometer 29.5 inches, Thermometer 85°. The apparent altitude of sun's lower limb 33° 0'; the apparent altitude of sun's centre 33° 16'. We have

EQUAL ALTITUDES.

A M.	P. M.
Mean refraction $\frac{1}{1} \frac{29}{29}$	Mean refraction $\frac{1}{1} \frac{29}{29}$
Barom. 30 in. 0	Barom. 29.5 in. —1
Therm. 55° —1	Therm. 85° —6
True refraction $\frac{1}{1} \frac{28}{28}$	True refraction $\frac{1}{1} \frac{22}{22}$

Then the difference of the sextant readings is 10' (=600'') and the corresponding diff. of chronometer times is about 26^s ; whence

$$\frac{600}{600} : \frac{6}{26} = \frac{8.}{26} : \frac{8.}{0.26}$$

The (approximate) Chronometer Time of Mean Noon was found to be	h. m. s. 5 6 59.5
Correction for change of refraction	+0.3
True Chronometer Time of Mean Noon	5 6 59.8

NOTE. — This correction may be found by the following rule, which we should have to resort to when but one altitude was taken at each observation. Add together the log. of the diff. of refractions (Tab. II.), log. cosine of the altitude, log. secant of the latitude, log. secant of the declination, log. cosecant of half elapsed time (or if the elapsed time is greater than 12^h, half its supplement to 24^h), and the constant log. 8.523; the sum is the log. (Table II.) of the required correction. Thus in the preceding example we have

Diff. refr.	6''	log.	0.778
Alt. ☉	33° 16'	log. cos.	9.922
Lat.	38° 59'	log. sec.	0.109
Dec.	15° 53'	log. sec.	0.017
El. T.	7 ^h . 49 ^m .	log. cosec.*	0.069
		const. log.	8.523
Correction	0 ^s .26	log.	9.418

DEGREE OF DEPENDENCE.

An error of 5' in the latitude would not affect the corresponding part of the equation of equal altitudes by more than one hundredth of its amount in the most unfavorable case, and in general would have no sensible effect. It is one of the advantages of the equal altitude method, therefore, that it does not require an accurate knowledge of the latitude. It is also plain that errors in the longitude affecting the declination and its hourly difference produce but small proportionate effects upon the computed equation. The absolute error of the chronometer on Greenwich will be affected by the whole error in the longitude, but the *rate* will still be correct. Hence we conclude that by this method the chronometer may be accurately *rated* at a place whose latitude and longitude are both imperfectly known.

The chief source of error is in the observation itself. The most practised observers with the sextant cannot depend on the noted time of a *single* contact within 0^s.5, and hence the intervals between the successive chronometer times (which, if observations could be perfectly taken would be sensibly equal) may differ 2^s. But the greatest probable error of the chronometer time of sun's or star's transit, from the mean of six such observations on each side of the meridian, is found to be not more than 0^s.2, provided the rate of the chronometer between the observations is uniform.

Errors resulting from changes in the refraction may be almost wholly removed by computation as above.

* Enter BOWDITCH'S Table XXVII., column P. M., with the *whole* elapsed time and take out the corresponding cosecant.

EXPLANATION OF THE TABLES.

TABLE I. — *Logarithms of A and B, for computing the Equation of Equal Altitudes*, are calculated by the formulas

$$A = \frac{E}{1800 \sin \frac{1}{2} E}, \quad B = \frac{E}{1800 \tan \frac{1}{2} E},$$

where E = elapsed time in minutes, and E in the denominator is the elapsed time expressed in arc.

If we put

ϕ = latitude of the place of observation, + north, — south,

δ = declination of the sun, + north, — south,

Δ = hourly change of declination, + north, — south,

χ = correction to reduce the middle chronometer time to chronometer time of apparent noon, algebraically additive,

χ' = the same for midnight,

we have

$$\begin{aligned} \chi &= - A \Delta \tan \phi + B \Delta \tan \delta \\ \chi' &= A \Delta \tan \phi + B \Delta \tan \delta. \end{aligned}$$

TABLE II. — *Logarithms of Numbers* to four decimal places. The first two figures of the number are found in the left-hand column, the third at the top, and the corresponding logarithm opposite and under these respectively. The proportional part for the fourth figure is found on the side in the same line with the logarithm taken out. The proper characteristic of the logarithm is to be supplied by the usual rule.

TABLE III. — *Mean Refraction*, reduced from BESSEL'S Tables, to barometer 30 inches, and thermometer 50°.

TABLES III. A. and III. B. — *Corrections of the Mean Refraction for the Height of the Barometer and Thermometer*, also deduced from BESSEL'S Tables. These are the same as Tables IV. A. and IV. B., given in the Appendix to the Nautical Almanac for 1855, where they are used for finding the corrections of the *Mean Reduced Refraction for Lunars*. It is for the purpose of having the same table for correcting both these mean refraction tables, that the argument in Tables III. A. and III. B. is the mean refraction instead of the apparent altitude.

TABLE IV. — *For converting Sidereal into Mean Solar Time*. This table gives the correction required to reduce a sidereal interval to its equivalent solar interval.

TABLE I. LOG. A. AND LOG. B.

For Computing the Equation of Equal Altitudes.

For Noon, A — }
For Midnight, A + }

ARGUMENT = ELAPSED TIME.

{ For Noon or
Midnight, B + }

Elapsed Time.	0 ^h .		1 ^h .		2 ^h .		3 ^h .		4 ^h .		5 ^h .	
	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.
m												
0	9.4059	9.4059	9.4072	9.4034	9.4109	9.3959	9.4172	9.3828	9.4260	9.3635	9.4374	9.3369
1	.4059	.4059	.4072	.4034	.4110	.3957	.4173	.3825	.4261	.3631	.4376	.3364
2	.4059	.4059	.4073	.4033	.4111	.3955	.4174	.3822	.4263	.3627	.4378	.3358
3	.4059	.4059	.4073	.4032	.4112	.3953	.4175	.3820	.4265	.3624	.4380	.3353
4	.4059	.4059	.4074	.4031	.4113	.3952	.4177	.3817	.4266	.3620	.4383	.3348
5	9.4059	9.4059	9.4074	9.4030	9.4113	9.3950	9.4178	9.3814	9.4268	9.3616	9.4385	9.3343
6	.4060	.4059	.4074	.4029	.4114	.3948	.4179	.3811	.4270	.3612	.4387	.3337
7	.4060	.4059	.4075	.4028	.4115	.3946	.4181	.3809	.4272	.3608	.4389	.3332
8	.4060	.4059	.4075	.4027	.4116	.3944	.4182	.3806	.4273	.3604	.4391	.3327
9	.4060	.4059	.4076	.4026	.4117	.3943	.4183	.3803	.4275	.3600	.4393	.3321
10	9.4060	9.4059	9.4076	9.4025	9.4118	9.3941	9.4184	9.3800	9.4277	9.3596	9.4396	9.3316
11	.4060	.4059	.4077	.4024	.4119	.3939	.4186	.3797	.4279	.3592	.4398	.3311
12	.4060	.4058	.4077	.4023	.4120	.3937	.4187	.3794	.4280	.3588	.4400	.3305
13	.4060	.4058	.4078	.4022	.4121	.3935	.4188	.3792	.4282	.3584	.4402	.3300
14	.4060	.4058	.4078	.4021	.4121	.3933	.4190	.3789	.4284	.3580	.4405	.3294
15	9.4060	9.4058	9.4079	9.4020	9.4122	9.3931	9.4191	9.3786	9.4286	9.3576	9.4407	9.3289
16	.4060	.4058	.4079	.4019	.4123	.3929	.4193	.3783	.4288	.3572	.4409	.3283
17	.4060	.4057	.4080	.4018	.4124	.3927	.4194	.3780	.4289	.3568	.4411	.3278
18	.4061	.4057	.4080	.4017	.4125	.3925	.4195	.3777	.4291	.3564	.4414	.3272
19	.4061	.4057	.4081	.4016	.4126	.3923	.4197	.3774	.4293	.3559	.4416	.3266
20	9.4061	9.4057	9.4081	9.4015	9.4127	9.3921	9.4198	9.3771	9.4295	9.3555	9.4418	9.3261
21	.4061	.4056	.4082	.4014	.4128	.3919	.4199	.3768	.4297	.3551	.4420	.3255
22	.4061	.4056	.4083	.4013	.4129	.3917	.4201	.3765	.4299	.3547	.4423	.3249
23	.4061	.4056	.4083	.4012	.4130	.3915	.4202	.3762	.4300	.3542	.4425	.3244
24	.4061	.4055	.4084	.4010	.4131	.3913	.4204	.3759	.4302	.3538	.4427	.3238
25	9.4062	9.4055	9.4084	9.4009	9.4132	9.3911	9.4205	9.3756	9.4304	9.3534	9.4430	9.3232
26	.4062	.4055	.4085	.4008	.4133	.3909	.4207	.3752	.4306	.3530	.4432	.3226
27	.4062	.4054	.4086	.4007	.4134	.3907	.4208	.3749	.4308	.3525	.4434	.3220
28	.4062	.4054	.4086	.4006	.4135	.3905	.4209	.3746	.4310	.3521	.4437	.3214
29	.4062	.4054	.4087	.4004	.4136	.3903	.4211	.3743	.4312	.3516	.4439	.3208
30	9.4062	9.4053	9.4087	9.4003	9.4137	9.3900	9.4212	9.3740	9.4314	9.3512	9.4441	9.3203
31	.4063	.4053	.4088	.4002	.4138	.3898	.4214	.3737	.4315	.3508	.4444	.3197
32	.4063	.4052	.4089	.4001	.4139	.3896	.4215	.3733	.4317	.3503	.4446	.3191
33	.4063	.4052	.4089	.3999	.4140	.3894	.4217	.3730	.4319	.3499	.4448	.3185
34	.4063	.4051	.4090	.3998	.4141	.3892	.4218	.3727	.4321	.3494	.4451	.3178
35	9.4064	9.4051	9.4091	9.3997	9.4142	9.3889	9.4220	9.3723	9.4323	9.3490	9.4453	9.3172
36	.4064	.4050	.4091	.3995	.4144	.3887	.4221	.3720	.4325	.3485	.4456	.3166
37	.4064	.4050	.4092	.3994	.4145	.3885	.4223	.3717	.4327	.3480	.4458	.3160
38	.4064	.4049	.4093	.3993	.4146	.3882	.4224	.3713	.4329	.3476	.4460	.3154
39	.4065	.4049	.4093	.3991	.4147	.3880	.4226	.3710	.4331	.3471	.4463	.3148
40	9.4065	9.4048	9.4094	9.3990	9.4148	9.3878	9.4227	9.3707	9.4333	9.3467	9.4465	9.3142
41	.4065	.4048	.4095	.3988	.4149	.3875	.4229	.3703	.4335	.3462	.4468	.3135
42	.4065	.4047	.4095	.3987	.4150	.3873	.4231	.3700	.4337	.3457	.4470	.3129
43	.4066	.4047	.4096	.3985	.4151	.3871	.4232	.3696	.4339	.3453	.4473	.3123
44	.4066	.4046	.4097	.3984	.4152	.3868	.4234	.3693	.4341	.3448	.4475	.3116
45	9.4066	9.4045	9.4097	9.3982	9.4154	9.3866	9.4235	9.3690	9.4343	9.3443	9.4477	9.3110
46	.4067	.4045	.4098	.3981	.4155	.3863	.4237	.3686	.4345	.3438	.4480	.3103
47	.4067	.4044	.4099	.3979	.4156	.3861	.4238	.3683	.4347	.3433	.4482	.3097
48	.4067	.4043	.4100	.3978	.4157	.3859	.4240	.3679	.4349	.3429	.4485	.3091
49	.4068	.4043	.4100	.3976	.4158	.3856	.4242	.3675	.4351	.3424	.4487	.3084
50	9.4068	9.4042	9.4101	9.3975	9.4159	9.3854	9.4243	9.3672	9.4353	9.3419	9.4490	9.3078
51	.4068	.4041	.4102	.3973	.4161	.3851	.4245	.3668	.4355	.3414	.4492	.3071
52	.4069	.4041	.4103	.3972	.4162	.3849	.4246	.3665	.4357	.3409	.4494	.3064
53	.4069	.4040	.4103	.3970	.4163	.3846	.4248	.3661	.4359	.3404	.4497	.3058
54	.4069	.4039	.4104	.3969	.4164	.3843	.4250	.3657	.4361	.3399	.4500	.3051
55	9.4070	9.4038	9.4105	9.3967	9.4165	9.3841	9.4251	9.3654	9.4363	9.3394	9.4503	9.3044
56	.4070	.4038	.4106	.3965	.4167	.3838	.4253	.3650	.4366	.3389	.4505	.3038
57	.4071	.4037	.4107	.3964	.4168	.3836	.4255	.3646	.4368	.3384	.4508	.3031
58	.4071	.4036	.4107	.3962	.4169	.3833	.4256	.3643	.4370	.3379	.4510	.3024
59	.4071	.4035	.4108	.3960	.4170	.3830	.4258	.3639	.4372	.3374	.4513	.3017
60	9.4072	9.4034	9.4109	9.3959	9.4172	9.3828	9.4260	9.3635	9.4374	9.3369	9.4515	9.3010

TABLE I. LOG. A. AND LOG. B.

For Computing the Equation of Equal Altitudes.

For Noon, A — For Midnight, A + }		ARGUMENT = ELAPSED TIME.										{ For Noon or Midnight, B + }	
Elapsed Time.	6 ^h .		7 ^h .		8 ^h .		9 ^h .		10 ^h .		11 ^h .		
	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.	
m													
0	9.4515	9.3010	9.4685	9.2530	9.4884	9.1874	9.5115	9.0943	9.5379	8.9509	9.5680	8.6837	
1	.4518	.3003	.4688	.2520	.4888	.1861	.5119	.0925	.5384	.9478	.5685	.6770	
2	.4521	.2996	.4691	.2511	.4892	.1848	.5123	.0906	.5389	.9447	.5691	.6701	
3	.4523	.2989	.4694	.2502	.4895	.1835	.5127	.0887	.5393	.9416	.5696	.6632	
4	.4526	.2982	.4697	.2492	.4899	.1822	.5132	.0867	.5398	.9384	.5701	.6560	
5	9.4528	9.2975	9.4701	9.2483	9.4902	9.1809	9.5136	9.0848	9.5403	8.9352	9.5707	8.6488	
6	.4531	.2968	.4704	.2473	.4906	.1796	.5140	.0828	.5408	.9320	.5712	.6414	
7	.4534	.2961	.4707	.2463	.4910	.1782	.5144	.0809	.5412	.9287	.5718	.6339	
8	.4536	.2954	.4710	.2454	.4913	.1769	.5148	.0789	.5417	.9254	.5723	.6262	
9	.4539	.2947	.4713	.2444	.4917	.1756	.5153	.0769	.5422	.9221	.5728	.6183	
10	9.4542	9.2940	9.4716	9.2434	9.4921	9.1742	9.5157	9.0749	9.5427	8.9187	9.5734	8.6103	
11	.4544	.2932	.4719	.2425	.4924	.1728	.5161	.0729	.5432	.9153	.5739	.6021	
12	.4547	.2925	.4723	.2415	.4928	.1715	.5165	.0708	.5436	.9118	.5745	.5937	
13	.4550	.2918	.4726	.2405	.4932	.1701	.5169	.0688	.5441	.9083	.5750	.5852	
14	.4552	.2911	.4729	.2395	.4935	.1687	.5174	.0667	.5446	.9048	.5756	.5764	
15	9.4555	9.2903	9.4732	9.2385	9.4939	9.1673	9.5178	9.0646	9.5451	8.9013	9.5761	8.5674	
16	.4558	.2896	.4735	.2375	.4943	.1659	.5182	.0625	.5456	.8977	.5767	.5583	
17	.4561	.2888	.4738	.2365	.4946	.1645	.5186	.0604	.5461	.8940	.5772	.5488	
18	.4563	.2881	.4742	.2355	.4950	.1630	.5191	.0583	.5466	.8903	.5778	.5392	
19	.4566	.2873	.4745	.2344	.4954	.1616	.5195	.0561	.5470	.8866	.5783	.5293	
20	9.4569	9.2866	9.4748	9.2334	9.4958	9.1602	9.5199	9.0540	9.5475	8.8829	9.5789	8.5192	
21	.4572	.2858	.4751	.2324	.4961	.1587	.5204	.0518	.5480	.8791	.5794	.5088	
22	.4574	.2850	.4755	.2313	.4965	.1573	.5208	.0496	.5485	.8752	.5800	.4981	
23	.4577	.2843	.4758	.2303	.4969	.1558	.5212	.0474	.5490	.8713	.5806	.4871	
24	.4580	.2835	.4761	.2292	.4973	.1543	.5217	.0452	.5495	.8674	.5811	.4758	
25	9.4583	9.2827	9.4764	9.2282	9.4977	9.1528	9.5221	9.0429	9.5500	8.8634	9.5817	8.4641	
26	.4585	.2819	.4768	.2271	.4980	.1513	.5225	.0406	.5505	.8594	.5822	.4521	
27	.4588	.2812	.4771	.2261	.4984	.1498	.5230	.0383	.5510	.8553	.5828	.4397	
28	.4591	.2804	.4774	.2250	.4988	.1483	.5234	.0360	.5515	.8512	.5834	.4270	
29	.4594	.2796	.4778	.2239	.4992	.1468	.5238	.0337	.5520	.8470	.5839	.4138	
30	9.4597	9.2788	9.4781	9.2228	9.4996	9.1453	9.5243	9.0314	9.5525	8.8427	9.5845	8.4001	
31	.4600	.2780	.4784	.2217	.5000	.1437	.5247	.0290	.5530	.8384	.5851	.3860	
32	.4602	.2772	.4788	.2206	.5003	.1422	.5252	.0266	.5535	.8341	.5856	.3713	
33	.4605	.2764	.4791	.2195	.5007	.1406	.5256	.0242	.5540	.8297	.5862	.3561	
34	.4608	.2756	.4794	.2184	.5011	.1390	.5261	.0218	.5545	.8253	.5868	.3403	
35	9.4611	9.2747	9.4798	9.2173	9.5015	9.1375	9.5265	9.0194	9.5550	8.8208	9.5874	8.3239	
36	.4614	.2739	.4801	.2162	.5019	.1359	.5269	.0169	.5555	.8162	.5879	.3067	
37	.4617	.2731	.4804	.2151	.5023	.1343	.5274	.0144	.5560	.8115	.5885	.2888	
38	.4620	.2723	.4808	.2140	.5027	.1327	.5278	.0119	.5565	.8068	.5891	.2701	
39	.4622	.2714	.4811	.2128	.5031	.1310	.5283	.0094	.5570	.8020	.5897	.2505	
40	9.4625	9.2706	9.4815	9.2117	9.5035	9.1294	9.5287	9.0069	9.5576	8.7972	9.5902	8.2299	
41	.4628	.2698	.4818	.2105	.5038	.1278	.5292	.0043	.5581	.7923	.5908	.2082	
42	.4631	.2689	.4821	.2094	.5042	.1261	.5296	.0017	.5586	.7873	.5914	.1853	
43	.4634	.2681	.4825	.2082	.5046	.1244	.5301	.89991	.5591	.7823	.5920	.1611	
44	.4637	.2672	.4828	.2070	.5050	.1228	.5305	.9985	.5596	.7772	.5926	.1354	
45	9.4640	9.2664	9.4832	9.2059	9.5054	9.1211	9.5310	8.9938	9.5601	8.7720	9.5931	8.1080	
46	.4643	.2655	.4835	.2047	.5058	.1194	.5315	.9911	.5606	.7668	.5937	.0786	
47	.4646	.2646	.4839	.2035	.5062	.1177	.5319	.9884	.5612	.7614	.5943	.0470	
48	.4649	.2638	.4842	.2023	.5066	.1159	.5324	.9857	.5617	.7560	.5949	.0128	
49	.4652	.2629	.4846	.2011	.5070	.1142	.5328	.9830	.5622	.7505	.5955	.79756	
50	9.4655	9.2620	9.4849	9.1999	9.5074	9.1125	9.5333	8.9802	9.5627	8.7449	9.5961	7.9348	
51	.4658	.2611	.4853	.1987	.5078	.1107	.5337	.9774	.5632	.7392	.5967	.8897	
52	.4661	.2602	.4856	.1974	.5082	.1089	.5342	.9745	.5638	.7335	.5973	.8391	
53	.4664	.2593	.4860	.1962	.5086	.1072	.5347	.9717	.5643	.7276	.5979	.7817	
54	.4667	.2584	.4863	.1950	.5091	.1054	.5351	.9688	.5648	.7217	.5985	.7154	
55	9.4670	9.2575	9.4867	9.1937	9.5095	9.1036	9.5356	8.9659	9.5654	8.7156	9.5991	7.6368	
56	.4673	.2566	.4870	.1925	.5099	.1017	.5361	.9630	.5659	.7094	.5997	.5405	
57	.4676	.2557	.4874	.1912	.5103	.0999	.5365	.9600	.5664	.7032	.6003	.4162	
58	.4679	.2548	.4877	.1900	.5107	.0981	.5370	.9570	.5669	.6968	.6009	.2407	
59	.4682	.2539	.4881	.1887	.5111	.0962	.5375	.9540	.5675	.6903	.6015	6.9591	
60	9.4685	9.2530	9.4884	9.1874	9.5115	9.0943	9.5379	8.9509	9.5680	8.6837	9.6021	Inf.	

TABLE I. LOG. A. AND LOG. B.

For Computing the Equation of Equal Altitudes.

For Noon, A — For Midnight, A + }		ARGUMENT = ELAPSED TIME.										{ For Noon or Midnight, B —	
Elapsed Time.	12 ^h .		13 ^h .		14 ^h .		15 ^h .		16 ^h .		17 ^h .		
	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.	
m													
0	9.6021	<i>Inf.</i>	9.6406	8.7563	9.6841	9.0971	9.7333	9.3162	9.7895	9.4884	9.8539	9.6383	
1	.6027	6.9603	.6412	.7641	.6848	.1014	.7342	.3194	.7905	.4911	.8550	.6407	
2	.6033	7.2431	.6419	.7718	.6856	.1057	.7351	.3225	.7915	.4937	.8562	.6431	
3	.6039	.4198	.6426	.7794	.6864	.1099	.7360	.3256	.7925	.4963	.8573	.6455	
4	.6045	.5453	.6433	.7868	.6872	.1141	.7369	.3287	.7935	.4990	.8585	.6478	
5	9.6051	7.6428	9.6440	8.7942	9.6879	9.1183	9.7378	9.3319	9.7945	9.5016	9.8597	9.6502	
6	.6057	.7226	.6447	.8015	.6887	.1224	.7386	.3350	.7955	.5042	.8608	.6526	
7	.6063	.7902	.6454	.8087	.6895	.1265	.7395	.3380	.7965	.5068	.8620	.6550	
8	.6069	.8488	.6461	.8158	.6903	.1306	.7404	.3411	.7975	.5094	.8632	.6573	
9	.6075	.9005	.6467	.8227	.6911	.1347	.7413	.3442	.7986	.5120	.8644	.6597	
10	9.6082	7.9469	9.6474	8.8296	9.6919	9.1387	9.7422	9.3472	9.7996	9.5146	9.8655	9.6621	
11	.6088	.9889	.6481	.8364	.6926	.1428	.7431	.3503	.8006	.5171	.8667	.6644	
12	.6094	8.0273	.6488	.8432	.6934	.1468	.7440	.3533	.8016	.5197	.8679	.6668	
13	.6100	.0627	.6495	.8498	.6942	.1507	.7449	.3563	.8027	.5223	.8691	.6691	
14	.6106	.0955	.6502	.8564	.6950	.1547	.7458	.3593	.8037	.5248	.8703	.6715	
15	9.6112	8.1260	9.6509	8.8628	9.6958	9.1586	9.7467	9.3623	9.8047	9.5274	9.8715	9.6738	
16	.6119	.1547	.6516	.8692	.6966	.1625	.7476	.3653	.8058	.5300	.8727	.6762	
17	.6125	.1816	.6523	.8756	.6974	.1664	.7485	.3683	.8068	.5325	.8739	.6785	
18	.6131	.2071	.6530	.8818	.6982	.1703	.7494	.3713	.8078	.5351	.8751	.6809	
19	.6137	.2312	.6538	.8880	.6990	.1741	.7503	.3742	.8089	.5376	.8763	.6832	
20	9.6144	8.2541	9.6545	8.8941	9.6998	9.1779	9.7512	9.3772	9.8099	9.5401	9.8775	9.6856	
21	.6150	.2759	.6552	.9002	.7006	.1817	.7522	.3801	.8110	.5427	.8787	.6879	
22	.6156	.2967	.6559	.9062	.7014	.1855	.7531	.3831	.8120	.5452	.8799	.6903	
23	.6163	.3166	.6566	.9121	.7022	.1893	.7540	.3860	.8131	.5477	.8812	.6926	
24	.6169	.3357	.6573	.9180	.7030	.1930	.7549	.3889	.8141	.5502	.8824	.6949	
25	9.6175	8.3540	9.6580	8.9238	9.7038	9.1967	9.7558	9.3918	9.8152	9.5528	9.8836	9.6973	
26	.6182	.3717	.6588	.9295	.7047	.2004	.7568	.3947	.8162	.5553	.8848	.6996	
27	.6188	.3887	.6595	.9352	.7055	.2041	.7577	.3976	.8173	.5578	.8861	.7019	
28	.6194	.4051	.6602	.9408	.7063	.2078	.7586	.4005	.8184	.5603	.8873	.7043	
29	.6201	.4210	.6609	.9464	.7071	.2114	.7595	.4033	.8194	.5628	.8885	.7066	
30	9.6207	8.4363	9.6616	8.9519	9.7079	9.2150	9.7605	9.4062	9.8205	9.5653	9.8898	9.7089	
31	.6214	.4512	.6624	.9573	.7088	.2186	.7614	.4090	.8216	.5677	.8910	.7112	
32	.6220	.4657	.6631	.9627	.7096	.2222	.7624	.4119	.8227	.5702	.8923	.7136	
33	.6226	.4796	.6638	.9681	.7104	.2258	.7633	.4147	.8237	.5727	.8935	.7159	
34	.6233	.4932	.6645	.9734	.7112	.2293	.7642	.4175	.8248	.5752	.8948	.7182	
35	9.6239	8.5064	9.6653	8.9787	9.7121	9.2329	9.7652	9.4204	9.8259	9.5777	9.8961	9.7205	
36	.6246	.5192	.6660	.9839	.7129	.2364	.7661	.4232	.8270	.5801	.8973	.7228	
37	.9252	.5318	.6667	.9891	.7137	.2399	.7671	.4260	.8281	.5826	.8986	.7251	
38	.6259	.5440	.6675	.9942	.7146	.2434	.7680	.4288	.8292	.5850	.8999	.7275	
39	.6265	.5559	.6682	.9993	.7154	.2468	.7690	.4316	.8303	.5875	.9011	.7298	
40	9.6272	8.5675	9.6690	9.0043	9.7162	9.2503	9.7699	9.4343	9.8314	9.5900	9.9024	9.7321	
41	.6279	.5788	.6697	.0093	.7171	.2537	.7709	.4371	.8325	.5924	.9037	.7344	
42	.6285	.5899	.6704	.0142	.7179	.2571	.7718	.4399	.8336	.5948	.9050	.7367	
43	.6292	.6008	.6712	.0191	.7187	.2605	.7728	.4426	.8347	.5973	.9063	.7390	
44	.6298	.6114	.6719	.0240	.7196	.2639	.7738	.4454	.8358	.5997	.9075	.7413	
45	9.6305	8.6218	9.6727	9.0288	9.7204	9.2673	9.7747	9.4481	9.8369	9.6022	9.9088	9.7436	
46	.6311	.6320	.6734	.0336	.7213	.2706	.7757	.4509	.8380	.6046	.9101	.7459	
47	.6318	.6419	.6742	.0384	.7221	.2740	.7767	.4536	.8391	.6070	.9114	.7482	
48	.6325	.6517	.6749	.0431	.7230	.2773	.7776	.4563	.8402	.6094	.9127	.7505	
49	.6331	.6613	.6757	.0478	.7238	.2806	.7786	.4590	.8414	.6119	.9140	.7529	
50	9.6338	8.6707	9.6764	9.0524	9.7247	9.2839	9.7796	9.4617	9.8425	9.6143	9.9154	9.7552	
51	.6345	.6799	.6772	.0570	.7256	.2872	.7806	.4644	.8436	.6167	.9167	.7575	
52	.6351	.6890	.6779	.0616	.7264	.2905	.7815	.4671	.8447	.6191	.9180	.7598	
53	.6358	.6979	.6787	.0662	.7273	.2937	.7825	.4698	.8459	.6215	.9193	.7621	
54	.6365	.7067	.6795	.0707	.7281	.2970	.7835	.4725	.8470	.6239	.9206	.7644	
55	9.6372	8.7153	9.6802	9.0752	9.7290	9.3002	9.7845	9.4752	9.8481	9.6263	9.9220	9.7667	
56	.6378	.7237	.6810	.0796	.7299	.3034	.7855	.4778	.8493	.6287	.9233	.7690	
57	.6385	.7321	.6818	.0840	.7307	.3066	.7865	.4805	.8504	.6311	.9246	.7713	
58	.6392	.7402	.6825	.0884	.7316	.3098	.7875	.4831	.8516	.6335	.9260	.7736	
59	.6399	.7483	.6833	.0928	.7324	.3130	.7885	.4858	.8527	.6359	.9273	.7759	
60	9.6406	8.7563	9.6841	9.0971	9.7333	9.3162	9.7895	9.4884	9.8539	9.6383	9.9287	9.7782	

TABLE I. LOG. A. AND LOG. B.

For Computing the Equation of Equal Altitudes.

For Noon, A — } For Midnight, A + }		ARGUMENT = ELAPSED TIME.										{ For Noon or Midnight, B —	
Elapsed Time.	m	18 ^h .		19 ^h .		20 ^h .		21 ^h .		22 ^h .		23 ^h .	
		Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.	Log. A.	Log. B.
	0	9.9287	9.7782	0.0172	9.9167	0.1249	0.0625	0.2623	0.2279	0.4523	0.4372	0.7689	0.7652
	1	.9300	.7804	.0188	.9190	.1269	.0650	.2649	.2309	.4562	.4414	.7765	.7729
	2	.9314	.7827	.0204	.9213	.1290	.0676	.2676	.2339	.4601	.4455	.7842	.7807
	3	.9327	.7850	.0221	.9237	.1310	.0701	.2702	.2370	.4640	.4497	.7920	.7886
	4	.9341	.7873	.0237	.9260	.1330	.0727	.2729	.2401	.4680	.4540	.8000	.7967
	5	9.9355	9.7896	0.0253	9.9284	0.1351	0.0753	0.2756	0.2431	0.4720	0.4582	0.8081	0.8049
	6	.9368	.7919	.0270	.9307	.1371	.0779	.2783	.2462	.4761	.4625	.8163	.8133
	7	.9382	.7942	.0286	.9331	.1392	.0805	.2810	.2493	.4801	.4668	.8247	.8218
	8	.9396	.7965	.0303	.9355	.1412	.0830	.2838	.2524	.4842	.4711	.8333	.8305
	9	.9410	.7988	.0319	.9378	.1433	.0856	.2865	.2556	.4884	.4755	.8420	.8393
	10	9.9424	9.8011	0.0336	9.9402	0.1454	0.0882	0.2893	0.2587	0.4926	0.4799	0.8508	0.8483
	11	.9437	.8034	.0353	.9426	.1475	.0909	.2921	.2619	.4968	.4844	.8599	.8575
	12	.9451	.8057	.0370	.9449	.1496	.0935	.2949	.2650	.5010	.4889	.8691	.8667
	13	.9465	.8080	.0386	.9473	.1517	.0961	.2977	.2682	.5053	.4934	.8786	.8763
	14	.9479	.8103	.0403	.9497	.1538	.0987	.3005	.2714	.5097	.4980	.8882	.8860
	15	9.9493	9.8126	0.0420	9.9520	0.1559	0.1013	0.3034	0.2746	0.5140	0.5026	0.8980	0.8959
	16	.9508	.8149	.0437	.9544	.1581	.1040	.3063	.2778	.5184	.5072	.9080	.9060
	17	.9522	.8172	.0454	.9568	.1602	.1066	.3091	.2811	.5229	.5118	.9183	.9164
	18	.9536	.8195	.0472	.9592	.1623	.1093	.3120	.2843	.5274	.5165	.9288	.9270
	19	.9550	.8218	.0489	.9616	.1645	.1119	.3150	.2876	.5319	.5213	.9396	.9378
	20	9.9564	9.8241	0.0506	9.9640	0.1667	0.1146	0.3179	0.2909	0.5365	0.5261	0.9506	0.9489
	21	.9579	.8264	.0523	.9664	.1689	.1173	.3208	.2942	.5411	.5309	.9618	.9603
	22	.9593	.8287	.0541	.9687	.1711	.1200	.3238	.2975	.5458	.5358	.9734	.9719
	23	.9607	.8310	.0558	.9711	.1733	.1226	.3268	.3008	.5505	.5407	.9853	.9839
	24	.9622	.8333	.0576	.9735	.1755	.1253	.3298	.3041	.5553	.5457	.9975	.9961
	25	9.9636	9.8356	0.0593	9.9760	0.1777	0.1280	0.3328	0.3075	0.5601	0.5507	1.0100	1.0087
	26	.9651	.8379	.0611	.9784	.1799	.1308	.3359	.3109	.5649	.5557	.0228	.0216
	27	.9665	.8402	.0628	.9808	.1821	.1335	.3389	.3143	.5698	.5608	.0361	.0350
	28	.9680	.8425	.0646	.9832	.1844	.1362	.3420	.3177	.5748	.5660	.0497	.0487
	29	.9695	.8448	.0664	.9856	.1867	.1389	.3451	.3211	.5798	.5712	.0638	.0628
	30	9.9709	9.8471	0.0682	9.9880	0.1889	0.1417	0.3482	0.3245	0.5848	0.5764	1.0783	1.0774
	31	.9724	.8494	.0700	.9904	.1912	.1444	.3514	.3280	.5899	.5817	.0934	.0925
	32	.9739	.8517	.0718	.9929	.1935	.1472	.3545	.3315	.5951	.5871	.1089	.1081
	33	.9754	.8540	.0736	.9953	.1958	.1499	.3577	.3350	.6003	.5925	.1250	.1242
	34	.9769	.8563	.0754	.9977	.1981	.1527	.3609	.3385	.6056	.5979	.1416	.1409
	35	9.9784	9.8586	0.0772	0.0002	0.2004	0.1555	0.3641	0.3420	0.6110	0.6034	1.1590	1.1583
	36	.9798	.8609	.0790	.0026	.2028	.1582	.3674	.3456	.6164	.6090	.1770	.1764
	37	.9813	.8632	.0809	.0051	.2051	.1610	.3706	.3491	.6218	.6147	.1958	.1952
	38	.9829	.8655	.0827	.0075	.2075	.1638	.3739	.3527	.6273	.6204	.2154	.2149
	39	.9844	.8678	.0845	.0100	.2098	.1667	.3772	.3563	.6329	.6261	.2359	.2354
	40	9.9859	9.8701	0.0864	0.0124	0.2122	0.1695	0.3805	0.3599	0.6386	0.6319	1.2573	1.2569
	41	.9874	.8724	.0883	.0149	.2146	.1723	.3839	.3636	.6443	.6378	.2799	.2795
	42	.9889	.8748	.0901	.0173	.2170	.1751	.3873	.3673	.6501	.6438	.3037	.3033
	43	.9904	.8771	.0920	.0198	.2194	.1780	.3907	.3710	.6560	.6498	.3288	.3285
	44	.9920	.8794	.0939	.0223	.2218	.1808	.3941	.3747	.6619	.6559	.3554	.3552
	45	9.9935	9.8817	0.0958	0.0248	0.2243	0.1837	0.3975	0.3784	0.6679	0.6621	1.3837	1.3835
	46	.9951	.8840	.0976	.0272	.2267	.1866	.4010	.3822	.6740	.6684	.4140	.4138
	47	.9966	.8863	.0995	.0297	.2292	.1895	.4045	.3859	.6802	.6747	.4465	.4463
	48	.9982	.8887	.1015	.0322	.2316	.1924	.4080	.3897	.6865	.6811	.4815	.4814
	49	.9998	.8910	.1034	.0347	.2341	.1953	.4115	.3936	.6928	.6876	.5196	.5195
	50	0.0013	9.8933	0.1053	0.0372	0.2366	0.1982	0.4151	0.3974	0.6993	0.6942	1.5613	1.5612
	51	.0029	.8956	.1072	.0397	.2391	.2011	.4187	.4013	.7058	.7008	.6074	.6073
	52	.0044	.8980	.1092	.0422	.2416	.2040	.4223	.4052	.7124	.7076	.6588	.6587
	53	.0060	.9003	.1111	.0447	.2442	.2070	.4260	.4091	.7191	.7144	.7171	.7171
	54	.0076	.9026	.1131	.0473	.2467	.2099	.4297	.4130	.7259	.7214	.7844	.7843
	55	0.0092	9.9050	0.1150	0.0498	0.2493	0.2129	0.4334	0.4170	0.7328	0.7284	1.8638	1.8638
	56	.0108	.9073	.1170	.0523	.2518	.2159	.4371	.4210	.7398	.7355	.9610	.9610
	57	.0124	.9096	.1190	.0548	.2544	.2189	.4408	.4250	.7469	.7428	2.0863	2.0863
	58	.0140	.9120	.1209	.0574	.2570	.2219	.4446	.4291	.7541	.7501	.2627	.2627
	59	.0156	.9143	.1229	.0599	.2596	.2249	.4485	.4331	.7615	.7576	2.5640	2.5640
	60	0.0172	9.9167	0.1249	0.0625	0.2623	0.2279	0.4523	0.4372	0.7689	0.7652	Inf.	Inf.

TABLE II.

LOGARITHMS OF NUMBERS.

Natural Numbers.	0	1	2	3	4	5	6	7	8	9	Proportional Parts.								
											1	2	3	4	5	6	7	8	9
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	4	8	12	17	21	25	29	33	37
11	0414	0458	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19	23	26	30	34
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17	21	24	28	31
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16	19	22	26	29
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15	18	21	24	27
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	3	6	8	11	14	17	20	22	25
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13	16	18	21	24
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	2	5	7	10	12	15	17	20	22
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2	5	7	9	12	14	16	19	21
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11	13	16	18	20
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11	13	15	17	19
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10	12	14	16	18
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10	12	14	15	17
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9	11	13	15	17
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9	10	12	14	15
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8	10	11	13	15
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	13
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7	8	9	11	12
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6	8	9	10	12
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6	7	9	10	11
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6	7	8	10	11
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6	7	8	9	10
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	1	2	3	5	6	7	8	9	10
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5	7	8	9	10
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5	6	8	9	10
41	6128	6138	6149	6160	6171	6180	6191	6201	6212	6222	1	2	3	4	5	6	7	8	9
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5	6	7	8	9
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5	6	7	8	9
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5	6	7	8	9
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5	6	7	8	9
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5	6	7	7	8
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	5	6	7	8
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	4	5	6	7	8
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4	5	6	7	8
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4	5	6	7	7
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	7

TABLE II.

LOGARITHMS OF NUMBERS.

Natural Numbers.	0	1	2	3	4	5	6	7	8	9	Proportional Parts.								
											1	2	3	4	5	6	7	8	9
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4	5	5	6	7
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	2	2	3	4	5	5	6	7
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4	4	5	6	7
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4	4	5	6	7
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4	4	5	6	6
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	2	3	4	4	5	6	6
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	3	4	5	6	6
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	3	4	5	5	6
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3	4	5	5	6
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	3	4	5	5	6
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3	4	5	5	6
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	3	4	5	5	6
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	3	4	4	5	6
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	2	3	4	4	5	6
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	2	3	4	4	5	6
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	2	3	4	4	5	5
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	2	3	4	4	5	5
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3	4	4	5	5
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	5	5
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3	3	4	4	5
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3	3	4	4	5
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3	3	4	4	5
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3	3	4	4	5
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3	3	4	4	5
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3	3	4	4	5
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3	3	4	4	5
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	2	2	3	3	4	4	5
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	2	2	3	3	4	4	5
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2	3	3	4	4
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0	1	1	2	2	3	3	4	4
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	0	1	1	2	2	3	3	4	4
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0	1	1	2	2	3	3	4	4
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0	1	1	2	2	3	3	4	4
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	0	1	1	2	2	3	3	4	4
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0	1	1	2	2	3	3	4	4
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2	3	3	4	4
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0	1	1	2	2	3	3	4	4
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2	3	3	4	4

TABLE III. MEAN REFRACTION.

Barometer 30 inches. Fahrenheit's Thermometer 50°.

Apparent Altitude.	Mean Refraction.	Apparent Altitude.	Mean Refraction.	Apparent Altitude.	Mean Refraction.	Apparent Altitude.	Mean Refraction.	Apparent Altitude.	Mean Refraction.
0 0	36 29.4	9 30	5 35.1	15 0	3 34.1	25 0	2 4.4	42 0	1 4.7
0 1	24 53.6	35	5 32.4	10	3 31.7	10	2 3.4	20	1 3.9
2 0	18 25.5	40	5 29.6	20	3 29.4	20	2 2.5	40	1 3.2
3 0	14 25.1	45	5 27.0	30	3 27.1	30	2 1.6	43 0	1 2.4
4 0	11 44.4	50	5 24.3	40	3 24.8	40	2 0.7	20	1 1.7
		55	5 21.7	50	3 22.6	50	1 59.8	40	1 1.0
5 0	9 52.0	10 0	5 19.2	16 0	3 20.5	26 0	1 58.9	44 0	1 0.3
5	9 44.0	5	5 16.7	10	3 18.4	10	1 58.1	20	0 59.6
10	9 36.2	10	5 14.2	20	3 16.3	20	1 57.2	40	0 58.9
15	9 28.6	15	5 11.7	30	3 14.2	30	1 56.4	45 0	0 58.2
20	9 21.2	20	5 9.3	40	3 12.2	40	1 55.5	20	0 57.6
25	9 14.0	25	5 6.9	50	3 10.3	50	1 54.7	40	0 56.9
5 30	9 7.0	10 30	5 4.6	17 0	3 8.3	27 0	1 53.9	46 0	0 56.2
35	9 0.1	35	5 2.3	10	3 6.4	10	1 53.1	20	0 55.6
40	8 53.4	40	5 0.0	20	3 4.6	20	1 52.3	40	0 55.0
45	8 46.8	45	4 57.8	30	3 2.8	30	1 51.5	47 0	0 54.3
50	8 40.4	50	4 55.6	40	3 1.0	40	1 50.7	20	0 53.7
55	8 34.2	55	4 53.4	50	2 59.2	50	1 50.0	40	0 53.1
6 0	8 28.0	11 0	4 51.2	18 0	2 57.5	28 0	1 49.2	48 0	0 52.5
5	8 22.1	5	4 49.1	10	2 55.8	20	1 47.7	49 0	0 50.6
10	8 16.2	10	4 47.0	20	2 54.1	40	1 46.2	50 0	0 48.9
15	8 10.5	15	4 44.9	30	2 52.4	29 0	1 44.8	51 0	0 47.2
20	8 4.8	20	4 42.9	40	2 50.8	20	1 43.4	52 0	0 45.5
25	7 59.3	25	4 40.9	50	2 49.2	40	1 42.0	53 0	0 43.9
6 30	7 53.9	11 30	4 38.9	19 0	2 47.7	30 0	1 40.6	54 0	0 42.3
35	7 48.7	35	4 36.9	10	2 46.1	20	1 39.3	55 0	0 40.8
40	7 43.5	40	4 35.0	20	2 44.6	40	1 38.0	56 0	0 39.3
45	7 38.4	45	4 33.1	30	2 43.1	31 0	1 36.7	57 0	0 37.8
50	7 33.5	50	4 31.2	40	2 41.6	20	1 35.5	58 0	0 36.4
55	7 28.6	55	4 29.4	50	2 40.2	40	1 34.2	59 0	0 35.0
7 0	7 23.8	12 0	4 27.5	20 0	2 38.8	32 0	1 33.0	60 0	0 33.6
5	7 19.2	5	4 25.7	10	2 37.4	20	1 31.8	61 0	0 32.3
10	7 14.6	10	4 23.9	20	2 36.0	40	1 30.7	62 0	0 31.0
15	7 10.1	15	4 22.2	30	2 34.6	33 0	1 29.5	63 0	0 29.7
20	7 5.7	20	4 20.4	40	2 33.3	20	1 28.4	64 0	0 28.4
25	7 1.4	25	4 18.7	50	2 32.0	40	1 27.3	65 0	0 27.2
7 30	6 57.1	12 30	4 17.0	21 0	2 30.7	34 0	1 26.2	66 0	0 25.9
35	6 53.0	35	4 15.3	10	2 29.4	20	1 25.1	67 0	0 24.7
40	6 48.9	40	4 13.6	20	2 28.1	40	1 24.1	68 0	0 23.6
45	6 44.9	45	4 12.0	30	2 26.9	35 0	1 23.1	69 0	0 22.4
50	6 41.0	50	4 10.4	40	2 25.7	20	1 22.0	70 0	0 21.2
55	6 37.1	55	4 8.8	50	2 24.5	40	1 21.0	71 0	0 20.1
8 0	6 33.3	13 0	4 7.2	22 0	2 23.3	36 0	1 20.1	72 0	0 18.9
5	6 29.6	5	4 5.6	10	2 22.1	20	1 19.1	73 0	0 17.8
10	6 25.9	10	4 4.1	20	2 20.9	40	1 18.2	74 0	0 16.7
15	6 22.3	15	4 2.6	30	2 19.8	37 0	1 17.2	75 0	0 15.6
20	6 18.8	20	4 1.0	40	2 18.7	20	1 16.3	76 0	0 14.5
25	6 15.3	25	3 59.6	50	2 17.5	40	1 15.4	77 0	0 13.5
8 30	6 11.9	13 30	3 58.1	23 0	2 16.4	38 0	1 14.5	78 0	0 12.4
35	6 8.5	35	3 56.6	10	2 15.4	20	1 13.6	79 0	0 11.3
40	6 5.2	40	3 55.2	20	2 14.3	40	1 12.7	80 0	0 10.3
45	6 2.0	45	3 53.7	30	2 13.3	39 0	1 11.9	81 0	0 9.2
50	5 58.8	50	3 52.3	40	2 12.2	20	1 11.0	82 0	0 8.2
55	5 55.7	55	3 50.9	50	2 11.2	40	1 10.2	83 0	0 7.2
9 0	5 52.6	14 0	3 49.5	24 0	2 10.2	40 0	1 9.4	84 0	0 6.1
5	5 49.6	10	3 46.8	10	2 9.2	20	1 8.6	85 0	0 5.1
10	5 46.6	20	3 44.2	20	2 8.2	40	1 7.8	86 0	0 4.1
15	5 43.6	30	3 41.6	30	2 7.2	41 0	1 7.0	87 0	0 3.1
20	5 40.7	40	3 39.0	40	2 6.2	20	1 6.2	88 0	0 2.0
25	5 37.9	50	3 36.5	50	2 5.3	40	1 5.4	89 0	0 1.0
9 30	5 35.1	15 0	3 34.1	25 0	2 4.4	42 0	1 4.7	90 0	0 0.0

TABLE III. A.

Correction of the Mean Refraction for the Height of the Barometer.

Barometer.		MEAN REFRACTION.																			Barometer.	
Subtract.	0'		1'		2'		3'		4'		5'		6'		7'		8'		9'		10'	Add.
	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	
27.50	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	51
27.55	0	2	5	7	10	12	15	17	20	23	25	28	30	33	35	38	40	43	45	48	51	
27.60	0	2	5	7	10	12	14	17	19	22	24	27	29	31	34	36	39	41	44	46	49	
27.65	0	2	5	7	9	12	14	16	19	21	24	26	28	31	33	36	38	40	43	45	48	
27.70	0	2	5	7	9	11	14	16	18	21	23	25	28	30	32	35	37	39	42	44	47	
27.75	0	2	4	7	9	11	13	16	18	20	23	25	27	29	32	34	36	39	41	43	46	
27.80	0	2	4	7	9	11	13	15	18	20	22	24	27	29	31	33	35	38	40	42	45	
27.85	0	2	4	6	9	11	13	15	17	19	22	24	26	28	30	32	35	37	39	41	44	
27.90	0	2	4	6	8	10	13	15	17	19	21	23	25	27	30	32	34	36	38	40	43	
27.95	0	2	4	6	8	10	12	14	16	18	21	23	25	27	29	31	33	35	37	39	42	
28.00	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	41	
28.05	0	2	4	6	8	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37	39	
28.10	0	2	4	6	8	9	11	13	15	17	19	21	23	25	27	29	31	33	34	36	38	
28.15	0	2	4	6	7	9	11	13	15	17	19	20	22	24	26	28	30	32	34	36	37	
28.20	0	2	4	5	7	9	11	13	14	16	18	20	22	24	25	27	29	31	33	35	36	
28.25	0	2	3	5	7	9	10	12	14	16	18	19	21	23	25	26	28	30	32	34	35	
28.30	0	2	3	5	7	8	10	12	14	15	17	19	21	22	24	26	27	29	31	33	34	
28.35	0	2	3	5	7	8	10	12	13	15	17	18	20	22	23	25	27	28	30	32	33	
28.40	0	2	3	5	6	8	10	11	13	14	16	18	19	21	23	24	26	27	29	31	32	
28.45	0	2	3	5	6	8	9	11	12	14	16	17	19	20	22	23	25	27	28	30	31	
28.50	0	1	3	4	6	7	9	10	12	14	15	17	18	20	21	23	24	26	27	29	30	31.50
28.55	0	1	3	4	6	7	9	10	12	13	15	16	17	19	20	22	23	25	26	28	29	31.45
28.60	0	1	3	4	6	7	8	10	11	13	14	15	17	18	20	21	23	24	25	27	28	31.40
28.65	0	1	3	4	5	7	8	9	11	12	14	15	16	18	19	20	22	23	25	26	27	31.35
28.70	0	1	3	4	5	6	8	9	10	12	13	14	16	17	18	20	21	22	24	25	26	31.30
28.75	0	1	2	4	5	6	7	9	10	11	13	14	15	16	18	19	20	21	23	24	25	31.25
28.80	0	1	2	4	5	6	7	8	10	11	12	13	14	16	17	18	19	21	22	23	24	31.20
28.85	0	1	2	3	5	6	7	8	9	10	12	13	14	15	16	17	19	20	21	22	23	31.15
28.90	0	1	2	3	4	5	7	8	9	10	11	12	13	14	16	17	18	19	20	21	22	31.10
28.95	0	1	2	3	4	5	6	7	8	9	11	12	13	14	15	16	17	18	19	20	21	31.05
29.00	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	31.00
29.05	0	1	2	3	4	5	6	7	8	9	10	11	11	12	13	14	15	16	17	18	19	30.95
29.10	0	1	2	3	4	4	5	6	7	8	9	10	11	12	13	14	15	15	16	17	18	30.90
29.15	0	1	2	3	3	4	5	6	7	8	9	9	10	11	12	13	14	15	15	16	17	30.85
29.20	0	1	2	2	3	4	5	6	6	7	8	9	10	10	11	12	13	14	15	15	16	30.80
29.25	0	1	1	2	3	4	4	5	6	7	8	8	9	10	11	11	12	13	14	14	15	30.75
29.30	0	1	1	2	3	3	4	5	6	6	7	8	8	9	10	11	11	12	13	13	14	30.70
29.35	0	1	1	2	3	3	4	5	5	6	7	7	8	9	10	10	11	11	12	13	13	30.65
29.40	0	1	1	2	2	3	4	4	5	5	6	7	7	8	8	9	10	10	11	12	12	30.60
29.45	0	1	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	9	10	11	11	30.55
29.50	0	0	1	1	2	2	3	3	4	5	5	6	6	7	7	8	8	9	9	10	10	30.50
29.55	0	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	9	30.45
29.60	0	0	1	1	2	2	2	3	3	4	4	5	5	6	6	6	7	7	8	8	8	30.40
29.65	0	0	1	1	1	2	2	2	3	3	4	4	4	5	5	5	6	6	6	7	7	30.35
29.70	0	0	1	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	5	6	6	30.30
29.75	0	0	0	1	1	1	1	2	2	2	3	3	3	4	4	4	4	4	5	5	5	30.25
29.80	0	0	0	1	1	1	1	1	2	2	2	2	3	3	3	3	3	3	4	4	4	30.20
29.85	0	0	0	0	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3	30.15
29.90	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	30.10
29.95	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	30.05
30.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30.00
Subtract.	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	Add.
Barometer.	0'		1'		2'		3'		4'		5'		6'		7'		8'		9'		10'	Barometer.
MEAN REFRACTION.																						

TABLE III. B.

Correction of the Mean Refraction for the Height of the Thermometer.

Thermom.		MEAN REFRACTION.																				Thermom.				
Add.		0'		1'		2'		3'		4'		5'		6'		7'		8'		9'		10'		Add.		
		0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0		
— 10		0	4	8	12	16	20	24	28	33	37	41	46	50	55	60	65	70	75	80	85	90		— 10		
— 8		0	4	8	12	15	19	23	27	31	36	40	44	48	53	58	62	67	72	77	82	87		— 8		
— 6		0	4	7	11	15	19	22	26	30	34	38	42	47	51	55	60	64	69	74	79	84		— 6		
— 4		0	4	7	11	14	18	22	25	29	33	37	41	45	49	53	57	62	66	71	76	80		— 4		
— 2		0	3	7	10	14	17	21	24	28	31	35	39	43	47	51	55	59	64	68	72	77		— 2		
0		0	3	7	10	13	16	20	23	27	30	34	37	41	45	49	53	57	61	65	69	74		0		
2		0	3	6	9	12	16	19	22	25	29	32	36	39	43	47	50	54	58	62	66	70		2		
4		0	3	6	9	12	15	18	21	24	28	31	34	37	41	44	48	52	55	59	63	67		4		
6		0	3	6	8	11	14	17	20	23	26	29	32	36	39	42	46	49	53	56	60	64		6		
8		0	3	5	8	11	14	16	19	22	25	28	31	34	37	40	43	47	50	54	57	61		8		
10		0	3	5	8	10	13	15	18	21	24	26	29	32	35	38	41	44	48	51	54	58		10		
11		0	2	5	7	10	13	15	18	20	23	26	28	31	34	37	40	43	46	49	53	56		11		
12		0	2	5	7	10	12	15	17	20	22	25	28	30	33	36	39	42	45	48	51	54		12		
13		0	2	5	7	9	12	14	17	19	22	24	27	30	32	35	38	41	44	47	50	53		13		
14		0	2	5	7	9	11	14	16	19	21	24	26	29	31	34	37	40	42	45	48	51		14		
15		0	2	4	7	9	11	13	16	18	20	23	25	28	30	33	36	38	41	44	47	50		15		
16		0	2	4	6	9	11	13	15	18	20	22	25	27	29	32	35	37	40	43	45	48		16		
17		0	2	4	6	8	10	13	15	17	19	21	24	26	29	31	33	36	39	41	44	47		17		
18		0	2	4	6	8	10	12	14	16	19	21	23	25	28	30	32	35	37	40	43	45		18		
19		0	2	4	6	8	10	12	14	16	18	20	22	24	27	29	31	34	36	39	41	44		19		
20		0	2	4	6	8	9	11	13	15	17	19	22	24	26	28	30	33	35	37	40	42		20		
21		0	2	4	5	7	9	11	13	15	17	19	21	23	25	27	29	31	34	36	38	41		21		
22		0	2	3	5	7	9	11	12	14	16	18	20	22	24	26	28	30	32	35	37	39		22		
23		0	2	3	5	7	8	10	12	14	15	17	19	21	23	25	27	29	31	33	36	38		23		
24		0	2	3	5	6	8	10	11	13	15	17	18	20	22	24	26	28	30	32	34	36		24		
25		0	2	3	5	6	8	9	11	13	14	16	18	19	21	23	25	27	29	31	33	35		25		
26		0	1	3	4	6	7	9	11	12	14	15	17	19	20	22	24	26	28	29	31	33		26		
27		0	1	3	4	6	7	9	10	12	13	15	16	18	19	21	23	25	26	38	30	32		27		
28		0	1	3	4	5	7	8	10	11	12	14	15	17	19	20	22	23	25	27	29	30		28		
29		0	1	3	4	5	6	8	9	11	12	13	15	16	18	19	21	22	24	26	27	29		29		
30		0	1	2	4	5	6	7	9	10	11	13	14	15	17	18	20	21	23	24	26	28		30		
31		0	1	2	3	5	6	7	8	9	11	12	13	15	16	17	19	20	22	23	25	26		31		
32		0	1	2	3	4	6	7	8	9	10	11	13	14	15	16	18	19	20	22	23	25		32		
33		0	1	2	3	4	5	6	7	8	10	11	12	13	14	15	17	18	19	21	22	23		33		
34		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	17	18	19	21	22		34		
35		0	1	2	3	4	5	6	6	7	8	9	10	11	13	14	15	16	17	18	19	20		35		
36		0	1	2	3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		36		
37		0	1	2	3	3	4	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18		37		
38		0	1	1	2	3	4	4	5	6	7	7	8	9	10	11	12	13	13	14	15	16		38		
39		0	1	1	2	3	3	4	5	5	6	7	8	8	9	10	11	11	12	13	14	15		39		
40		0	1	1	2	2	3	4	4	5	6	6	7	8	8	9	10	10	11	12	13	13		40		
41		0	1	1	2	2	3	3	4	4	5	6	6	7	7	8	9	9	10	11	11	12		41		
42		0	0	1	1	2	2	3	3	4	4	5	5	6	7	7	8	8	9	9	10	11		42		
43		0	0	1	1	2	2	3	3	3	4	4	5	5	6	6	7	7	8	8	9	9		43		
44		0	0	1	1	1	2	2	3	3	3	4	4	4	5	5	6	6	7	7	8	8		44		
45		0	0	1	1	1	1	2	2	2	3	3	3	4	4	4	5	5	6	6	6	7		45		
46		0	0	0	1	1	1	1	2	2	2	2	3	3	4	4	4	4	5	5	5	5		46		
47		0	0	0	1	1	1	1	1	2	2	2	2	3	3	3	3	3	4	4	4	4		47		
48		0	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3		48		
49		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1		49		
50		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		50		
Add.		0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	30	0	Add.	
Thermom.		0'		1'		2'		3'		4'		5'		6'		7'		8'		9'		10'		Thermom.		
MEAN REFRACTION.																										

TABLE III. B.

Correction of the Mean Refraction for the Height of the Thermometer.

Thermom.	MEAN REFRACTION.												Thermom.
	0	1	2	3	4	5	6	7	8	9	10		
	Subtract.	Subtract.	Subtract.	Subtract.	Subtract.	Subtract.	Subtract.	Subtract.	Subtract.	Subtract.	Subtract.		
50	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	50	
51	0 0	0 0	0 0	0 0	0 0	0 1	1 1	1 1	1 1	1 1	1 1	51	
52	0 0	0 0	0 0	0 1	1 1	1 1	1 1	1 2	2 2	2 2	2 2	52	
53	0 0	0 0	1 1	1 1	1 1	1 2	2 2	2 2	2 3	3 3	3 4	53	
54	0 0	0 1	1 1	1 1	1 2	2 2	2 3	3 3	3 4	4 4	5 5	54	
55	0 0	1 1	1 1	1 2	2 2	2 3	3 3	4 4	4 5	5 5	6 6	55	
56	0 0	1 1	1 2	2 2	2 3	3 3	4 4	4 5	5 6	6 6	7 7	56	
57	0 0	1 1	2 2	2 3	3 3	4 4	4 5	5 6	6 6	7 7	8 8	57	
58	0 0	1 1	2 2	3 3	3 4	4 5	5 6	6 6	7 7	8 9	9 10	58	
59	0 1	1 2	2 3	3 4	4 5	5 6	6 7	7 8	8 8	9 10	10 11	59	
60	0 1	1 2	2 3	3 4	4 5	5 6	6 7	7 8	8 9	9 10	10 11	60	
61	0 1	1 2	3 3	4 4	5 6	6 7	7 8	8 9	9 10	10 11	11 12	61	
62	0 1	1 2	3 3	4 5	6 6	7 7	8 8	9 9	10 11	11 12	12 13	62	
63	0 1	1 2	3 4	5 5	6 7	7 8	8 8	9 10	10 11	11 12	12 13	63	
64	0 1	2 2	3 4	5 6	7 7	8 8	9 9	10 11	11 12	12 13	13 14	64	
65	0 1	2 3	3 4	5 6	7 8	8 9	9 10	10 11	11 12	12 13	13 14	65	
66	0 1	2 3	4 5	6 6	7 8	8 9	9 10	10 11	11 12	12 13	13 14	66	
67	0 1	2 3	4 5	6 7	7 8	8 9	9 10	10 11	11 12	12 13	13 14	67	
68	0 1	2 3	4 5	6 7	8 8	9 9	10 11	11 12	12 13	13 14	14 15	68	
69	0 1	2 3	4 5	7 8	9 9	10 11	11 12	12 13	13 14	14 15	15 16	69	
70	0 1	2 3	5 6	7 8	9 10	10 11	11 12	12 13	13 14	14 15	15 16	70	
71	0 1	2 4	5 6	7 8	9 10	10 11	11 12	12 13	13 14	14 15	15 16	71	
72	0 1	2 4	5 6	8 9	9 10	10 11	11 12	12 13	13 14	14 15	15 16	72	
73	0 1	3 4	5 7	8 9	10 11	11 12	12 13	13 14	14 15	15 16	16 17	73	
74	0 1	3 4	5 7	8 10	10 11	11 12	12 13	13 14	14 15	15 16	16 17	74	
75	0 1	3 4	6 7	8 10	10 11	11 12	12 13	13 14	14 15	15 16	16 17	75	
76	0 1	3 4	6 7	9 10	10 11	11 12	12 13	13 14	14 15	15 16	16 17	76	
77	0 1	3 5	6 8	9 11	10 12	11 13	12 14	13 15	14 16	15 17	16 18	77	
78	0 2	3 5	6 8	9 11	10 12	11 13	12 14	13 15	14 16	15 17	16 18	78	
79	0 2	3 5	6 8	10 11	11 12	12 13	13 14	14 15	15 16	16 17	17 18	79	
80	0 2	3 5	7 8	10 12	11 13	12 14	13 15	14 16	15 17	16 18	17 19	80	
81	0 2	3 5	7 9	10 12	11 13	12 14	13 15	14 16	15 17	16 18	17 19	81	
82	0 2	4 5	7 9	10 13	11 14	12 15	13 16	14 17	15 18	16 19	17 20	82	
83	0 2	4 5	7 9	11 13	12 14	13 15	14 16	15 17	16 18	17 19	18 20	83	
84	0 2	4 6	8 9	11 13	12 14	13 15	14 16	15 17	16 18	17 19	18 20	84	
85	0 2	4 6	8 10	12 14	13 15	14 16	15 17	16 18	17 19	18 20	19 21	85	
86	0 2	4 6	8 10	12 14	13 15	14 16	15 17	16 18	17 19	18 20	19 21	86	
87	0 2	4 6	8 10	12 14	13 15	14 16	15 17	16 18	17 19	18 20	19 21	87	
88	0 2	4 6	8 10	13 15	14 16	15 17	16 18	17 19	18 20	19 21	20 22	88	
89	0 2	4 6	9 11	13 15	14 16	15 17	16 18	17 19	18 20	19 21	20 22	89	
90	0 2	4 7	9 11	13 16	14 17	15 18	16 19	17 20	18 21	19 22	20 23	90	
91	0 2	4 7	9 11	14 16	15 17	16 18	17 19	18 20	19 21	20 22	21 23	91	
92	0 2	5 7	9 11	14 16	15 17	16 18	17 19	18 20	19 21	20 22	21 23	92	
93	0 2	5 7	9 12	14 17	15 18	16 19	17 20	18 21	19 22	20 23	21 24	93	
94	0 2	5 7	10 12	14 17	15 18	16 19	17 20	18 21	19 22	20 23	21 24	94	
95	0 2	5 7	10 12	15 17	16 18	17 19	18 20	19 21	20 22	21 23	22 24	95	
96	0 2	5 7	10 12	15 18	16 19	17 20	18 21	19 22	20 23	21 24	22 25	96	
97	0 3	5 8	10 13	15 18	16 19	17 20	18 21	19 22	20 23	21 24	22 25	97	
98	0 3	5 8	10 13	16 18	17 19	18 20	19 21	20 22	21 23	22 24	23 25	98	
99	0 3	5 8	11 13	16 19	17 20	18 21	19 22	20 23	21 24	22 25	23 26	99	
100	0 3	5 8	11 13	16 19	17 20	18 21	19 22	20 23	21 24	22 25	23 26	100	
Subtract.	0 30	0 30	0 30	0 30	0 30	0 30	0 30	0 30	0 30	0 30	0 30	Subtract.	
Thermom.	0	1	2	3	4	5	6	7	8	9	10	Thermom.	
MEAN REFRACTION.													

TABLE IV. SIDEREAL INTO MEAN SOLAR TIME.

Sidereal.	0 h.	1 h.	2 h.	3 h.	4 h.	5 h.	6 h.	7 h.	For Seconds.
m.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	s.
0	0 00.000	0 09.830	0 19.659	0 29.489	0 39.318	0 49.148	0 58.977	1 08.807	
1	0 00.164	0 09.993	0 19.823	0 29.653	0 39.482	0 49.312	0 59.141	1 08.971	1 0.003
2	0 00.328	0 10.157	0 19.987	0 29.816	0 39.646	0 49.475	0 59.305	1 09.135	2 .005
3	0 00.491	0 10.321	0 20.151	0 29.980	0 39.810	0 49.639	0 59.469	1 09.298	3 .008
4	0 00.655	0 10.485	0 20.314	0 30.144	0 39.974	0 49.803	0 59.633	1 09.462	4 .011
5	0 00.819	0 10.649	0 20.478	0 30.308	0 40.137	0 49.967	0 59.796	1 09.626	5 .014
6	0 00.983	0 10.813	0 20.642	0 30.472	0 40.301	0 50.131	0 59.960	1 09.790	6 .016
7	0 01.147	0 10.976	0 20.806	0 30.635	0 40.465	0 50.295	1 09.124	1 09.954	7 .019
8	0 01.311	0 11.140	0 20.970	0 30.799	0 40.629	0 50.458	1 09.288	1 10.118	8 .022
9	0 01.474	0 11.304	0 21.134	0 30.963	0 40.793	0 50.622	1 09.452	1 10.281	9 .025
10	0 01.638	0 11.468	0 21.297	0 31.127	0 40.956	0 50.786	1 09.616	1 10.445	10 .027
11	0 01.802	0 11.632	0 21.461	0 31.291	0 41.120	0 50.950	1 09.779	1 10.609	11 .030
12	0 01.966	0 11.795	0 21.625	0 31.455	0 41.284	0 51.114	1 09.943	1 10.773	12 .033
13	0 02.130	0 11.959	0 21.789	0 31.618	0 41.448	0 51.278	1 01.107	1 10.937	13 .035
14	0 02.294	0 12.123	0 21.953	0 31.782	0 41.612	0 51.441	1 01.271	1 11.100	14 .038
15	0 02.457	0 12.287	0 22.117	0 31.946	0 41.776	0 51.605	1 01.435	1 11.264	15 .041
16	0 02.621	0 12.451	0 22.280	0 32.110	0 41.939	0 51.769	1 01.599	1 11.428	16 .044
17	0 02.785	0 12.615	0 22.444	0 32.274	0 42.103	0 51.933	1 01.762	1 11.592	17 .046
18	0 02.949	0 12.778	0 22.608	0 32.438	0 42.267	0 52.097	1 01.926	1 11.756	18 .049
19	0 03.113	0 12.942	0 22.772	0 32.601	0 42.431	0 52.260	1 02.090	1 11.920	19 .052
20	0 03.277	0 13.106	0 22.936	0 32.765	0 42.595	0 52.424	1 02.254	1 12.083	20 .055
21	0 03.440	0 13.270	0 23.099	0 32.929	0 42.759	0 52.588	1 02.418	1 12.247	21 .057
22	0 03.604	0 13.434	0 23.263	0 33.093	0 42.922	0 52.752	1 02.582	1 12.411	22 .060
23	0 03.768	0 13.598	0 23.427	0 33.257	0 43.086	0 52.916	1 02.745	1 12.575	23 .063
24	0 03.932	0 13.761	0 23.591	0 33.420	0 43.250	0 53.080	1 02.909	1 12.739	24 .066
25	0 04.096	0 13.925	0 23.755	0 33.584	0 43.414	0 53.243	1 03.073	1 12.903	25 .068
26	0 04.259	0 14.089	0 23.919	0 33.748	0 43.578	0 53.407	1 03.237	1 13.066	26 .071
27	0 04.423	0 14.253	0 24.082	0 33.912	0 43.742	0 53.571	1 03.401	1 13.230	27 .074
28	0 04.587	0 14.417	0 24.246	0 34.076	0 43.905	0 53.735	1 03.564	1 13.394	28 .076
29	0 04.751	0 14.581	0 24.410	0 34.240	0 44.069	0 53.899	1 03.728	1 13.558	29 .079
30	0 04.915	0 14.744	0 24.574	0 34.403	0 44.233	0 54.063	1 03.892	1 13.722	30 .082
31	0 05.079	0 14.908	0 24.738	0 34.567	0 44.397	0 54.226	1 04.056	1 13.886	31 .085
32	0 05.242	0 15.072	0 24.902	0 34.731	0 44.561	0 54.390	1 04.220	1 14.049	32 .087
33	0 05.406	0 15.236	0 25.065	0 34.895	0 44.724	0 54.554	1 04.384	1 14.213	33 .090
34	0 05.570	0 15.400	0 25.229	0 35.059	0 44.888	0 54.718	1 04.547	1 14.377	34 .093
35	0 05.734	0 15.563	0 25.393	0 35.223	0 45.052	0 54.882	1 04.711	1 14.541	35 .096
36	0 05.898	0 15.727	0 25.557	0 35.386	0 45.216	0 55.046	1 04.875	1 14.705	36 .098
37	0 06.062	0 15.891	0 25.721	0 35.550	0 45.380	0 55.209	1 05.039	1 14.868	37 .101
38	0 06.225	0 16.055	0 25.885	0 35.714	0 45.544	0 55.373	1 05.203	1 15.032	38 .104
39	0 06.389	0 16.219	0 26.048	0 35.878	0 45.707	0 55.537	1 05.367	1 15.196	39 .106
40	0 06.553	0 16.383	0 26.212	0 36.042	0 45.871	0 55.701	1 05.530	1 15.360	40 .109
41	0 06.717	0 16.546	0 26.376	0 36.206	0 46.035	0 55.865	1 05.694	1 15.524	41 .112
42	0 06.881	0 16.710	0 26.540	0 36.369	0 46.199	0 56.028	1 05.858	1 15.688	42 .115
43	0 07.045	0 16.874	0 26.704	0 36.533	0 46.363	0 56.192	1 06.022	1 15.851	43 .117
44	0 07.208	0 17.038	0 26.867	0 36.697	0 46.527	0 56.356	1 06.186	1 16.015	44 .120
45	0 07.372	0 17.202	0 27.031	0 36.861	0 46.690	0 56.520	1 06.350	1 16.179	45 .123
46	0 07.536	0 17.366	0 27.195	0 37.025	0 46.854	0 56.684	1 06.513	1 16.343	46 .126
47	0 07.700	0 17.529	0 27.359	0 37.188	0 47.018	0 56.848	1 06.677	1 16.507	47 .128
48	0 07.864	0 17.693	0 27.523	0 37.352	0 47.182	0 57.011	1 06.841	1 16.671	48 .131
49	0 08.027	0 17.857	0 27.687	0 37.516	0 47.346	0 57.175	1 07.005	1 16.834	49 .134
50	0 08.191	0 18.021	0 27.850	0 37.680	0 47.510	0 57.339	1 07.169	1 16.998	50 .137
51	0 08.355	0 18.185	0 28.014	0 37.844	0 47.673	0 57.503	1 07.332	1 17.162	51 .139
52	0 08.519	0 18.349	0 28.178	0 38.008	0 47.837	0 57.667	1 07.496	1 17.326	52 .142
53	0 08.683	0 18.512	0 28.342	0 38.171	0 48.001	0 57.831	1 07.660	1 17.490	53 .145
54	0 08.847	0 18.676	0 28.506	0 38.335	0 48.165	0 57.994	1 07.824	1 17.654	54 .147
55	0 09.010	0 18.840	0 28.670	0 38.499	0 48.329	0 58.158	1 07.988	1 17.817	55 .150
56	0 09.174	0 19.004	0 28.833	0 38.663	0 48.492	0 58.322	1 08.152	1 17.981	56 .153
57	0 09.338	0 19.168	0 28.997	0 38.827	0 48.656	0 58.486	1 08.315	1 18.145	57 .156
58	0 09.502	0 19.331	0 29.161	0 38.991	0 48.820	0 58.650	1 08.479	1 18.309	58 .158
59	0 09.666	0 19.495	0 29.325	0 39.154	0 48.984	0 58.814	1 08.643	1 18.473	59 .161

TABLE IV. SIDEREAL INTO MEAN SOLAR TIME.

Sidereal.	8 h.	9 h.	10 h.	11 h.	12 h.	13 h.	14 h.	15 h.	For Seconds.
m.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	s. s.
0	1 18.636	1 28.466	1 38.296	1 48.125	1 57.955	2 07.784	2 17.614	2 27.443	1 0.003
1	1 18.800	1 28.630	1 38.459	1 48.289	1 58.119	2 07.948	2 17.778	2 27.607	2 .005
2	1 18.964	1 28.794	1 38.623	1 48.453	1 58.282	2 08.112	2 17.941	2 27.771	3 .008
3	1 19.128	1 28.958	1 38.787	1 48.617	1 58.446	2 08.276	2 18.105	2 27.935	4 .011
4	1 19.292	1 29.121	1 38.951	1 48.780	1 58.610	2 08.440	2 18.269	2 28.099	5 .014
5	1 19.456	1 29.285	1 39.115	1 48.944	1 58.774	2 08.603	2 18.433	2 28.263	6 .016
6	1 19.619	1 29.449	1 39.279	1 49.108	1 58.938	2 08.767	2 18.597	2 28.426	7 .019
7	1 19.783	1 29.613	1 39.442	1 49.272	1 59.101	2 08.931	2 18.761	2 28.590	8 .022
8	1 19.947	1 29.777	1 39.606	1 49.436	1 59.265	2 09.095	2 18.924	2 28.754	9 .025
9	1 20.111	1 29.940	1 39.770	1 49.600	1 59.429	2 09.259	2 19.088	2 28.918	10 .027
10	1 20.275	1 30.104	1 39.934	1 49.763	1 59.593	2 09.423	2 19.252	2 29.082	11 .030
11	1 20.439	1 30.268	1 40.098	1 49.927	1 59.757	2 09.586	2 19.416	2 29.245	12 .033
12	1 20.602	1 30.432	1 40.261	1 50.091	1 59.921	2 09.750	2 19.580	2 29.409	13 .035
13	1 20.766	1 30.596	1 40.425	1 50.255	2 00.084	2 09.914	2 19.744	2 29.573	14 .038
14	1 20.930	1 30.760	1 40.589	1 50.419	2 00.248	2 10.078	2 19.907	2 29.737	15 .041
15	1 21.094	1 30.923	1 40.753	1 50.583	2 00.412	2 10.242	2 20.071	2 29.901	16 .044
16	1 21.258	1 31.087	1 40.917	1 50.746	2 00.576	2 10.405	2 20.235	2 30.065	17 .046
17	1 21.422	1 31.251	1 41.081	1 50.910	2 00.740	2 10.569	2 20.399	2 30.228	18 .049
18	1 21.585	1 31.415	1 41.244	1 51.074	2 00.904	2 10.733	2 20.563	2 30.392	19 .052
19	1 21.749	1 31.579	1 41.408	1 51.238	2 01.067	2 10.897	2 20.727	2 30.556	20 .055
20	1 21.913	1 31.743	1 41.572	1 51.402	2 01.231	2 11.061	2 20.890	2 30.720	21 .057
21	1 22.077	1 31.906	1 41.736	1 51.565	2 01.395	2 11.225	2 21.054	2 30.884	22 .060
22	1 22.241	1 32.070	1 41.900	1 51.729	2 01.559	2 11.388	2 21.218	2 31.048	23 .063
23	1 22.404	1 32.234	1 42.064	1 51.893	2 01.723	2 11.552	2 21.382	2 31.211	24 .066
24	1 22.568	1 32.398	1 42.227	1 52.057	2 01.887	2 11.716	2 21.546	2 31.375	25 .068
25	1 22.732	1 32.562	1 42.391	1 52.221	2 02.050	2 11.880	2 21.709	2 31.539	26 .071
26	1 22.896	1 32.726	1 42.555	1 52.385	2 02.214	2 12.044	2 21.873	2 31.703	27 .074
27	1 23.060	1 32.889	1 42.719	1 52.548	2 02.378	2 12.208	2 22.037	2 31.867	28 .076
28	1 23.224	1 33.053	1 42.883	1 52.712	2 02.542	2 12.371	2 22.201	2 32.031	29 .079
29	1 23.387	1 33.217	1 43.047	1 52.876	2 02.706	2 12.535	2 22.365	2 32.194	30 .082
30	1 23.551	1 33.381	1 43.210	1 53.040	2 02.869	2 12.699	2 22.529	2 32.358	31 .085
31	1 23.715	1 33.545	1 43.374	1 53.204	2 03.033	2 12.863	2 22.692	2 32.522	32 .087
32	1 23.879	1 33.708	1 43.538	1 53.368	2 03.197	2 13.027	2 22.856	2 32.686	33 .090
33	1 24.043	1 33.872	1 43.702	1 53.531	2 03.361	2 13.191	2 23.020	2 32.850	34 .093
34	1 24.207	1 34.036	1 43.866	1 53.695	2 03.525	2 13.354	2 23.184	2 33.013	35 .096
35	1 24.370	1 34.200	1 44.029	1 53.859	2 03.689	2 13.518	2 23.348	2 33.177	36 .098
36	1 24.534	1 34.364	1 44.193	1 54.023	2 03.852	2 13.682	2 23.512	2 33.341	37 .101
37	1 24.698	1 34.528	1 44.357	1 54.187	2 04.016	2 13.846	2 23.675	2 33.505	38 .104
38	1 24.862	1 34.691	1 44.521	1 54.351	2 04.180	2 14.010	2 23.839	2 33.669	39 .106
39	1 25.026	1 34.855	1 44.685	1 54.514	2 04.344	2 14.173	2 24.003	2 33.833	40 .109
40	1 25.190	1 35.019	1 44.849	1 54.678	2 04.508	2 14.337	2 24.167	2 33.996	41 .112
41	1 25.353	1 35.183	1 45.012	1 54.842	2 04.672	2 14.501	2 24.331	2 34.160	42 .115
42	1 25.517	1 35.347	1 45.176	1 55.006	2 04.835	2 14.665	2 24.495	2 34.324	43 .117
43	1 25.681	1 35.511	1 45.340	1 55.170	2 04.999	2 14.829	2 24.658	2 34.488	44 .120
44	1 25.845	1 35.674	1 45.504	1 55.333	2 05.163	2 14.993	2 24.822	2 34.652	45 .123
45	1 26.009	1 35.838	1 45.668	1 55.497	2 05.327	2 15.156	2 24.986	2 34.816	46 .125
46	1 26.172	1 36.002	1 45.832	1 55.661	2 05.491	2 15.320	2 25.150	2 34.979	47 .128
47	1 26.336	1 36.166	1 45.995	1 55.825	2 05.655	2 15.484	2 25.314	2 35.143	48 .131
48	1 26.500	1 36.330	1 46.159	1 55.989	2 05.818	2 15.648	2 25.477	2 35.307	49 .134
49	1 26.664	1 36.493	1 46.323	1 56.153	2 05.982	2 15.812	2 25.641	2 35.471	50 .137
50	1 26.828	1 36.657	1 46.487	1 56.316	2 06.146	2 15.976	2 25.805	2 35.635	51 .139
51	1 26.992	1 36.821	1 46.651	1 56.480	2 06.310	2 16.139	2 25.969	2 35.798	52 .142
52	1 27.155	1 36.985	1 46.815	1 56.644	2 06.474	2 16.303	2 26.133	2 35.962	53 .145
53	1 27.319	1 37.149	1 46.978	1 56.808	2 06.637	2 16.467	2 26.297	2 36.126	54 .147
54	1 27.483	1 37.313	1 47.142	1 56.972	2 06.801	2 16.631	2 26.460	2 36.290	55 .150
55	1 27.647	1 37.476	1 47.306	1 57.136	2 06.965	2 16.795	2 26.624	2 36.454	56 .153
56	1 27.811	1 37.640	1 47.470	1 57.299	2 07.129	2 16.959	2 26.788	2 36.618	57 .156
57	1 27.975	1 37.804	1 47.634	1 57.463	2 07.293	2 17.122	2 26.952	2 36.781	58 .158
58	1 28.138	1 37.968	1 47.797	1 57.627	2 07.457	2 17.286	2 27.116	2 36.945	59 .161
59	1 28.302	1 38.132	1 47.961	1 57.791	2 07.620	2 17.450	2 27.280	2 37.109	

TABLE IV. SIDEREAL INTO MEAN SOLAR TIME.

Side- real	16 ^h .	17 ^h .	18 ^h .	19 ^h .	20 ^h .	21 ^h .	22 ^h .	23 ^h .	For Seconds.
m	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	s. s.
0	2 37.273	2 47.102	2 56.932	3 06.762	3 16.591	3 26.421	3 36.250	3 46.080	0.003
1	2 37.437	2 47.266	2 57.096	3 06.925	3 16.755	3 26.585	3 36.414	3 46.244	2.005
2	2 37.601	2 47.430	2 57.260	3 07.089	3 16.919	3 26.748	3 36.578	3 46.407	3.008
3	2 37.764	2 47.594	2 57.424	3 07.253	3 17.083	3 26.912	3 36.742	3 46.571	4.011
4	2 37.928	2 47.758	2 57.587	3 07.417	3 17.246	3 27.076	3 36.906	3 46.735	5.014
5	2 38.092	2 47.922	2 57.751	3 07.581	3 17.410	3 27.240	3 37.069	3 46.899	6.016
6	2 38.256	2 48.085	2 57.915	3 07.745	3 17.574	3 27.404	3 37.233	3 47.063	7.019
7	2 38.420	2 48.249	2 58.079	3 07.908	3 17.738	3 27.568	3 37.397	3 47.227	8.022
8	2 38.584	2 48.413	2 58.243	3 08.072	3 17.902	3 27.731	3 37.561	3 47.390	9.025
9	2 38.747	2 48.577	2 58.406	3 08.236	3 18.066	3 27.895	3 37.725	3 47.554	10.027
10	2 38.911	2 48.741	2 58.570	3 08.400	3 18.229	3 28.059	3 37.889	3 47.718	11.030
11	2 39.075	2 48.905	2 58.734	3 08.564	3 18.393	3 28.223	3 38.052	3 47.882	12.033
12	2 39.239	2 49.068	2 58.898	3 08.728	3 18.557	3 28.387	3 38.216	3 48.046	13.035
13	2 39.403	2 49.232	2 59.062	3 08.891	3 18.721	3 28.550	3 38.380	3 48.210	14.038
14	2 39.566	2 49.396	2 59.226	3 09.055	3 18.885	3 28.714	3 38.544	3 48.373	15.041
15	2 39.730	2 49.560	2 59.389	3 09.219	3 19.049	3 28.878	3 38.708	3 48.537	16.044
16	2 39.894	2 49.724	2 59.553	3 09.383	3 19.212	3 29.042	3 38.871	3 48.701	17.046
17	2 40.058	2 49.888	2 59.717	3 09.547	3 19.376	3 29.206	3 39.035	3 48.865	18.049
18	2 40.222	2 50.051	2 59.881	3 09.710	3 19.540	3 29.370	3 39.199	3 49.029	19.052
19	2 40.386	2 50.215	3 00.045	3 09.874	3 19.704	3 29.533	3 39.363	3 49.193	20.055
20	2 40.549	2 50.379	3 00.209	3 10.038	3 19.868	3 29.697	3 39.527	3 49.356	21.057
21	2 40.713	2 50.543	3 00.372	3 10.202	3 20.032	3 29.861	3 39.691	3 49.520	22.060
22	2 40.877	2 50.707	3 00.536	3 10.366	3 20.195	3 30.025	3 39.854	3 49.684	23.063
23	2 41.041	2 50.870	3 00.700	3 10.530	3 20.359	3 30.189	3 40.018	3 49.848	24.066
24	2 41.205	2 51.034	3 00.864	3 10.693	3 20.523	3 30.353	3 40.182	3 50.012	25.068
25	2 41.369	2 51.198	3 01.028	3 10.857	3 20.687	3 30.516	3 40.346	3 50.175	26.071
26	2 41.532	2 51.362	3 01.192	3 11.021	3 20.851	3 30.680	3 40.510	3 50.339	27.074
27	2 41.696	2 51.526	3 01.355	3 11.185	3 21.014	3 30.844	3 40.674	3 50.503	28.076
28	2 41.860	2 51.690	3 01.519	3 11.349	3 21.178	3 31.008	3 40.837	3 50.667	29.079
29	2 42.024	2 51.853	3 01.683	3 11.513	3 21.342	3 31.172	3 41.001	3 50.831	30.082
30	2 42.188	2 52.017	3 01.847	3 11.676	3 21.506	3 31.336	3 41.165	3 50.995	31.085
31	2 42.352	2 52.181	3 02.011	3 11.840	3 21.670	3 31.499	3 41.329	3 51.158	32.087
32	2 42.515	2 52.345	3 02.174	3 12.004	3 21.834	3 31.663	3 41.493	3 51.322	33.090
33	2 42.679	2 52.509	3 02.338	3 12.168	3 21.997	3 31.827	3 41.657	3 51.486	34.093
34	2 42.843	2 52.673	3 02.502	3 12.332	3 22.161	3 31.991	3 41.820	3 51.650	35.096
35	2 43.007	2 52.836	3 02.666	3 12.496	3 22.325	3 32.155	3 41.984	3 51.814	36.098
36	2 43.171	2 52.999	3 02.830	3 12.659	3 22.489	3 32.318	3 42.148	3 51.978	37.101
37	2 43.334	2 53.163	3 02.994	3 12.823	3 22.653	3 32.482	3 42.312	3 52.141	38.104
38	2 43.498	2 53.328	3 03.157	3 12.987	3 22.817	3 32.646	3 42.476	3 52.305	39.106
39	2 43.662	2 53.492	3 03.321	3 13.151	3 22.980	3 32.810	3 42.639	3 52.469	40.109
40	2 43.826	2 53.656	3 03.485	3 13.315	3 23.144	3 32.974	3 42.803	3 52.633	41.112
41	2 43.990	2 53.819	3 03.649	3 13.478	3 23.308	3 33.138	3 42.967	3 52.797	42.115
42	2 44.154	2 53.983	3 03.813	3 13.642	3 23.472	3 33.301	3 43.131	3 52.961	43.117
43	2 44.317	2 54.147	3 03.977	3 13.806	3 23.636	3 33.465	3 43.295	3 53.124	44.120
44	2 44.481	2 54.311	3 04.140	3 13.970	3 23.800	3 33.629	3 43.459	3 53.288	45.123
45	2 44.645	2 54.475	3 04.304	3 14.134	3 23.963	3 33.793	3 43.622	3 53.452	46.126
46	2 44.809	2 54.638	3 04.468	3 14.298	3 24.127	3 33.957	3 43.786	3 53.616	47.128
47	2 44.973	2 54.802	3 04.632	3 14.461	3 24.291	3 34.121	3 43.950	3 53.780	48.131
48	2 45.137	2 54.966	3 04.796	3 14.625	3 24.455	3 34.284	3 44.114	3 53.943	49.134
49	2 45.300	2 55.130	3 04.960	3 14.789	3 24.619	3 34.448	3 44.278	3 54.107	50.137
50	2 45.464	2 55.294	3 05.123	3 14.953	3 24.782	3 34.612	3 44.442	3 54.271	51.139
51	2 45.628	2 55.458	3 05.287	3 15.117	3 24.946	3 34.776	3 44.605	3 54.435	52.142
52	2 45.792	2 55.621	3 05.451	3 15.281	3 25.110	3 34.940	3 44.769	3 54.599	53.145
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